Sanford Lab Status

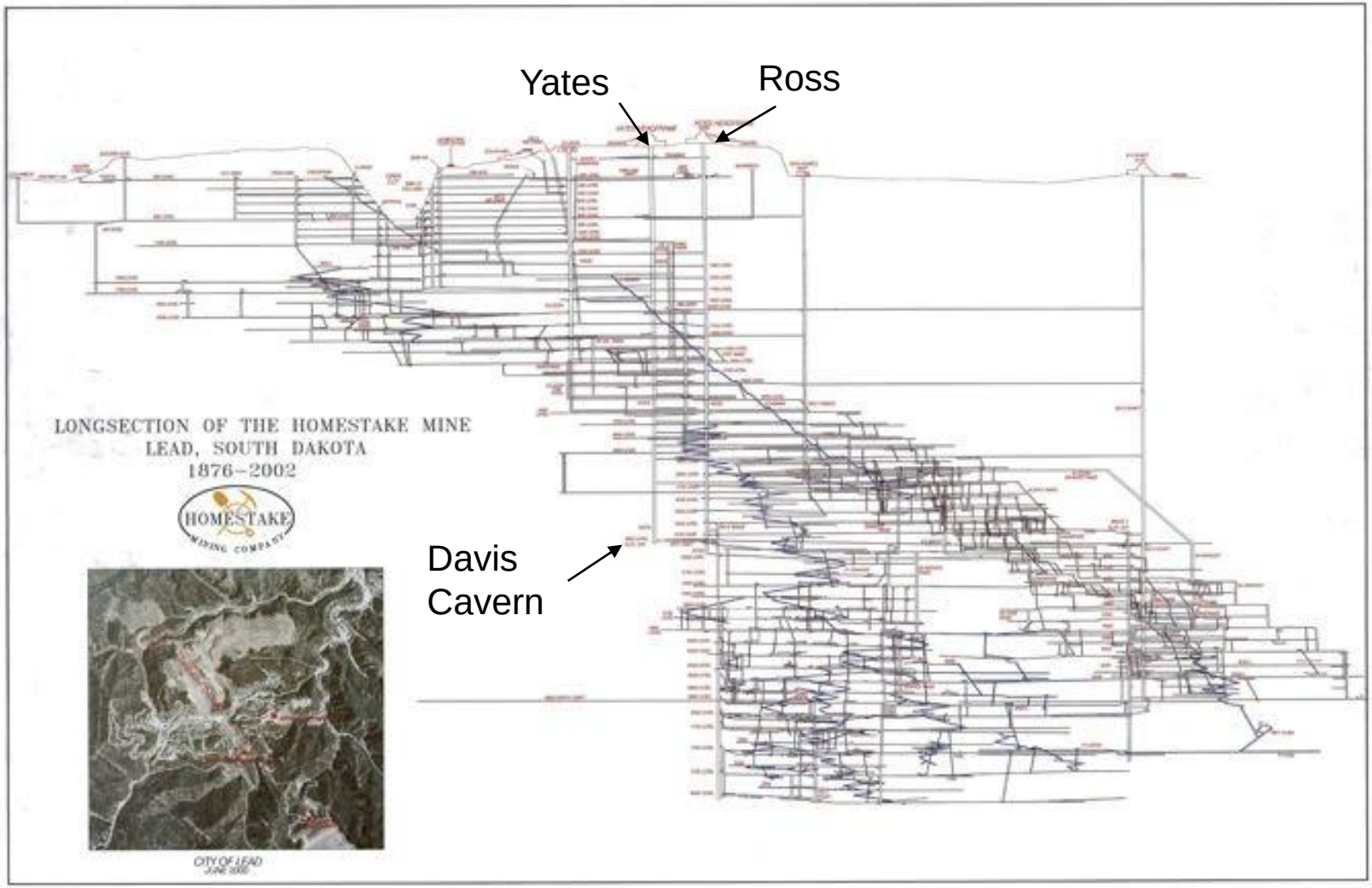
Jose Alonso
Director

Aerial View of Homestake

Ross Headframe

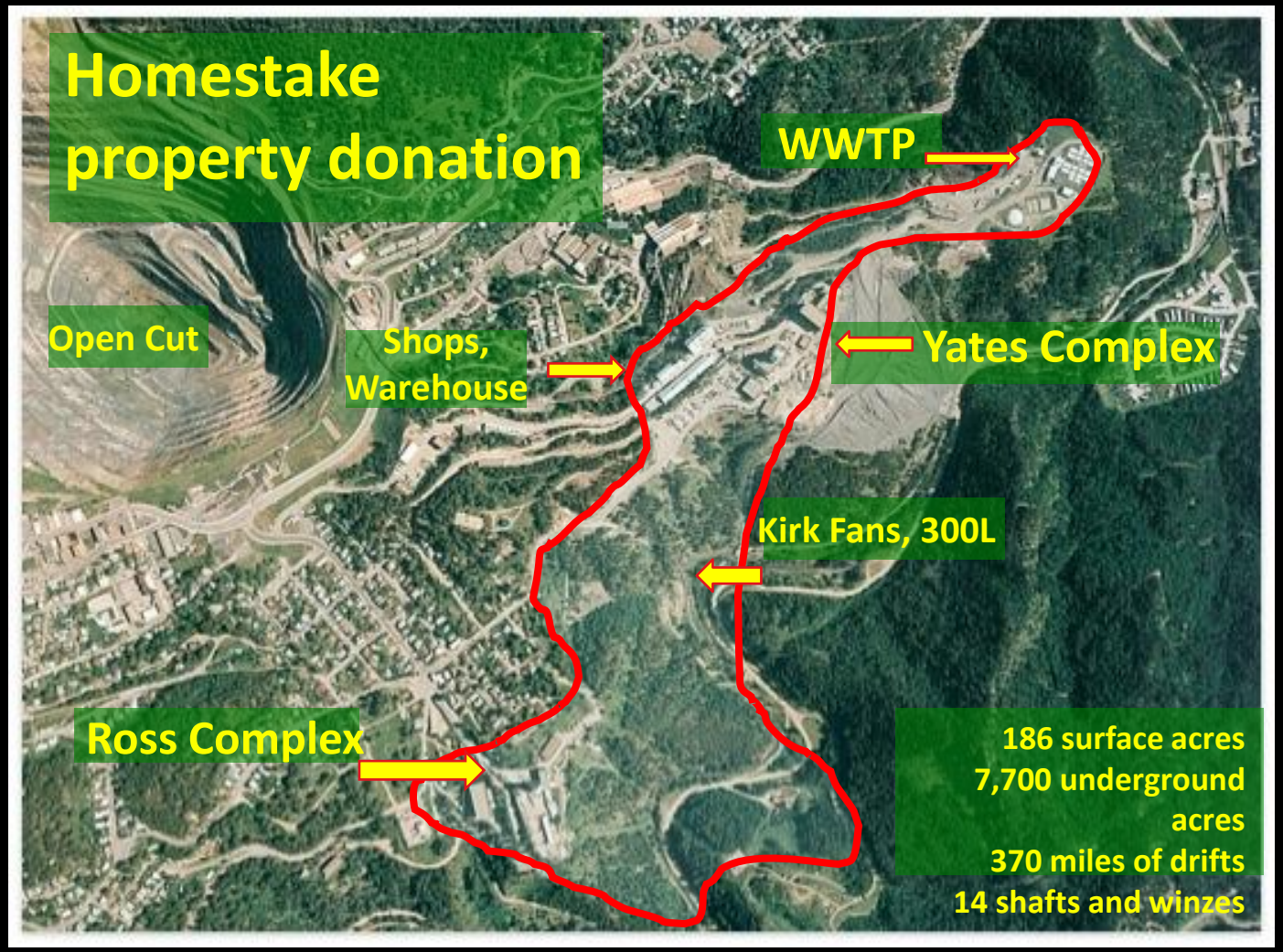
Yates Headframe

Section View of Homestake Mine



Orientation for “Long Section”

Homestake Footprint



Re-Entry Work Begins, June 2007

Rehabilitation of shafts and hoists

Lab Staff

- October 2007: 6 employees
- Feb 2009:
  - 68 Full Time
  - 26 Part time
  - Contractor staff on site ~ 25

Shaft Inspections

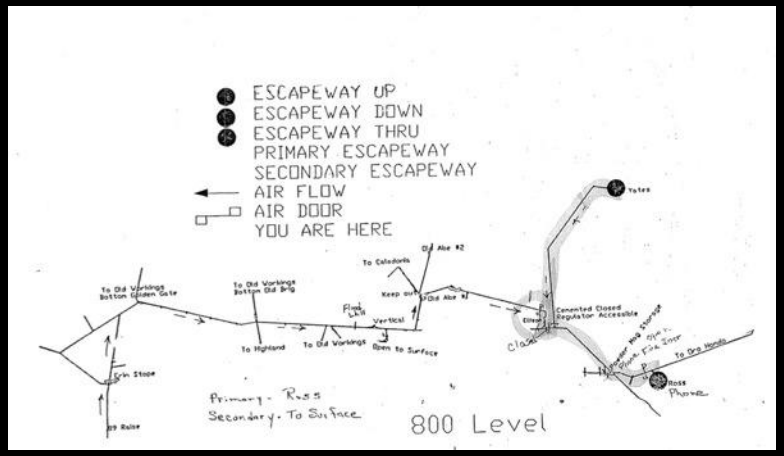
Refurbishing Steel Sets in Ross

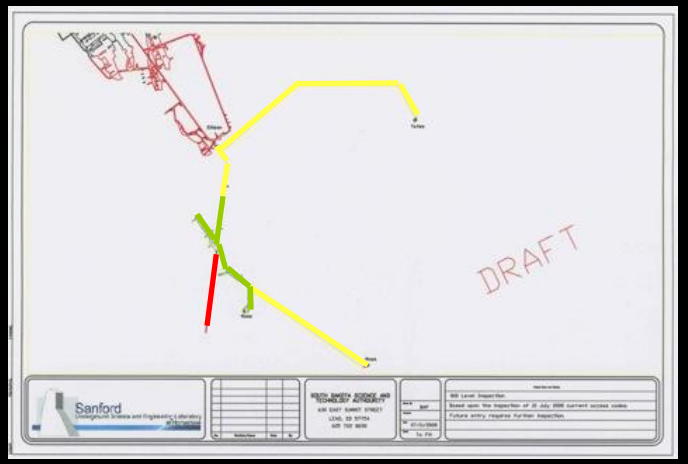
Newly-opened Mine Levels Inspected

Safety Assessments a top priority!

Access Control / Risk Assessment Strategies

- Access to a new level involves:
  - Inspection mission
    - Expert, experienced crew
    - Identify hazards
  - Evaluation of risks
    - Determine level of risk
    - Develop maps for allowed access
  - Mitigation plans for more extensive access





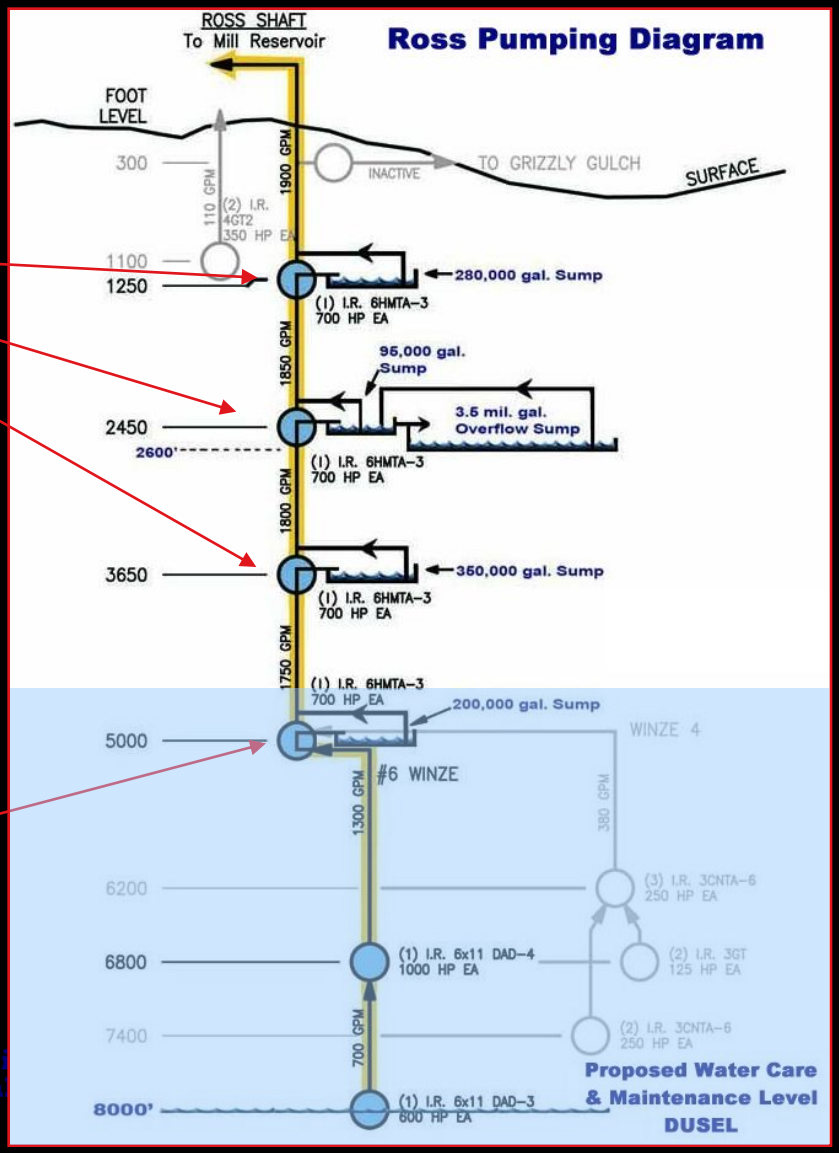
Water-Removal Challenges

Stationary Pump System

3 stations
- 1500 gpm pumps
- 700 hp motors

1250 foot pumping head
- 12” pump columns

(4th station underwater)



Pump Re-Installation

Re-commissioning
of pump chain
to begin de-watering

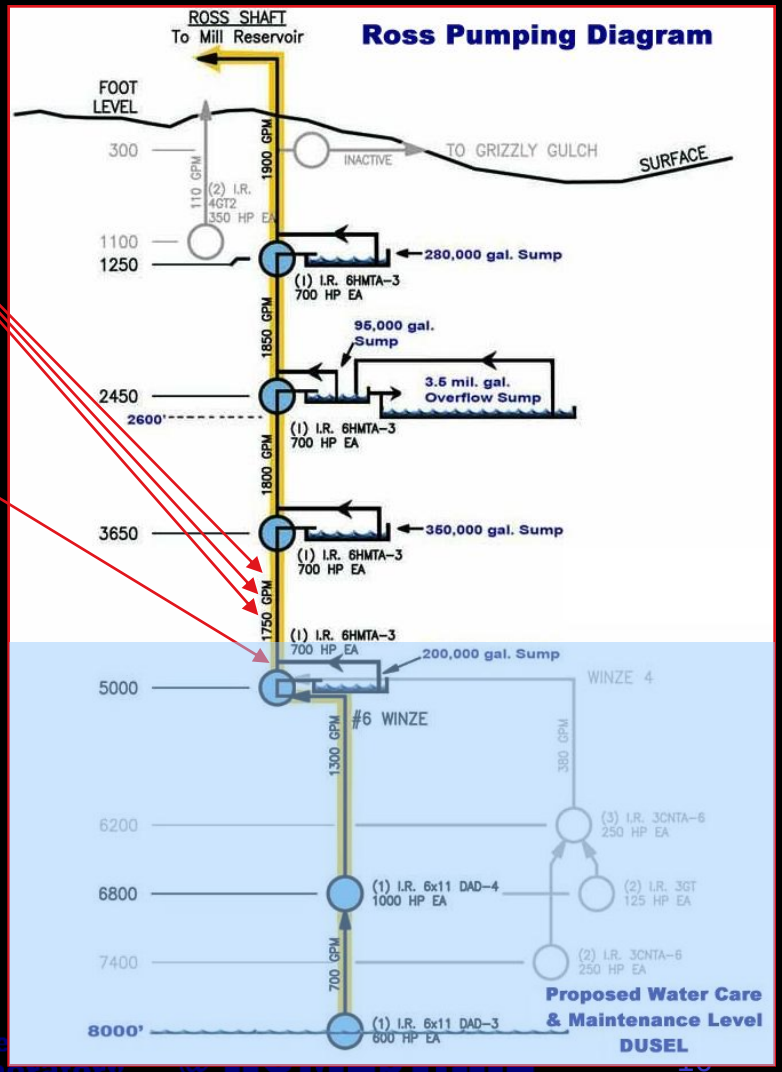
1250L Stationary Pump and Controller

2450L Stationary Pump

Completing the Chain

Stations at 3950L, 4250L, 4550L
- 4 submersible pumps per station
- 450-500gpm each; 1800-2000 total

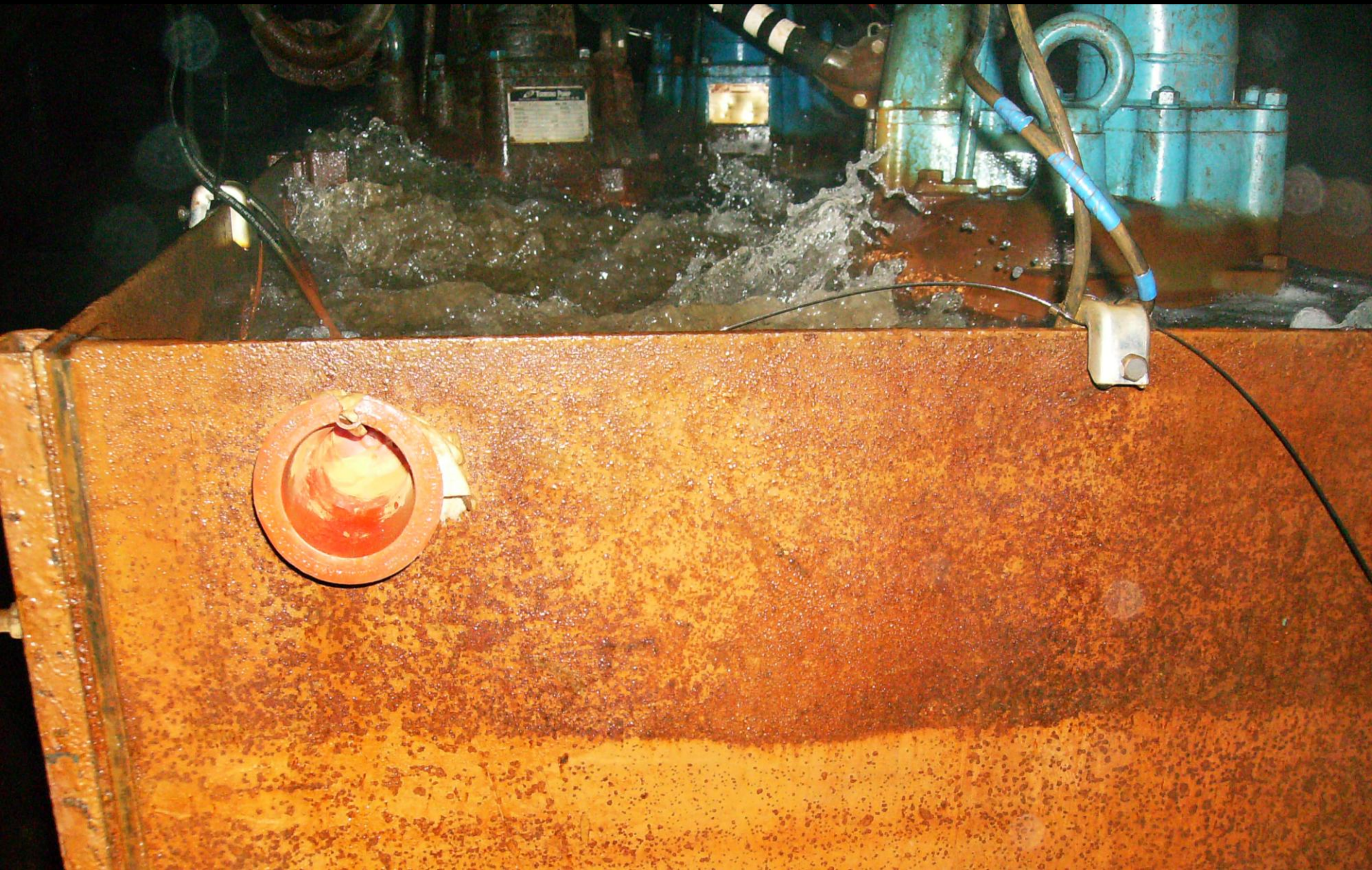
Ross Shaft pool pumping capacity
- 1 submersible pump at 4850 feet
- 1500-1800gpm capacity



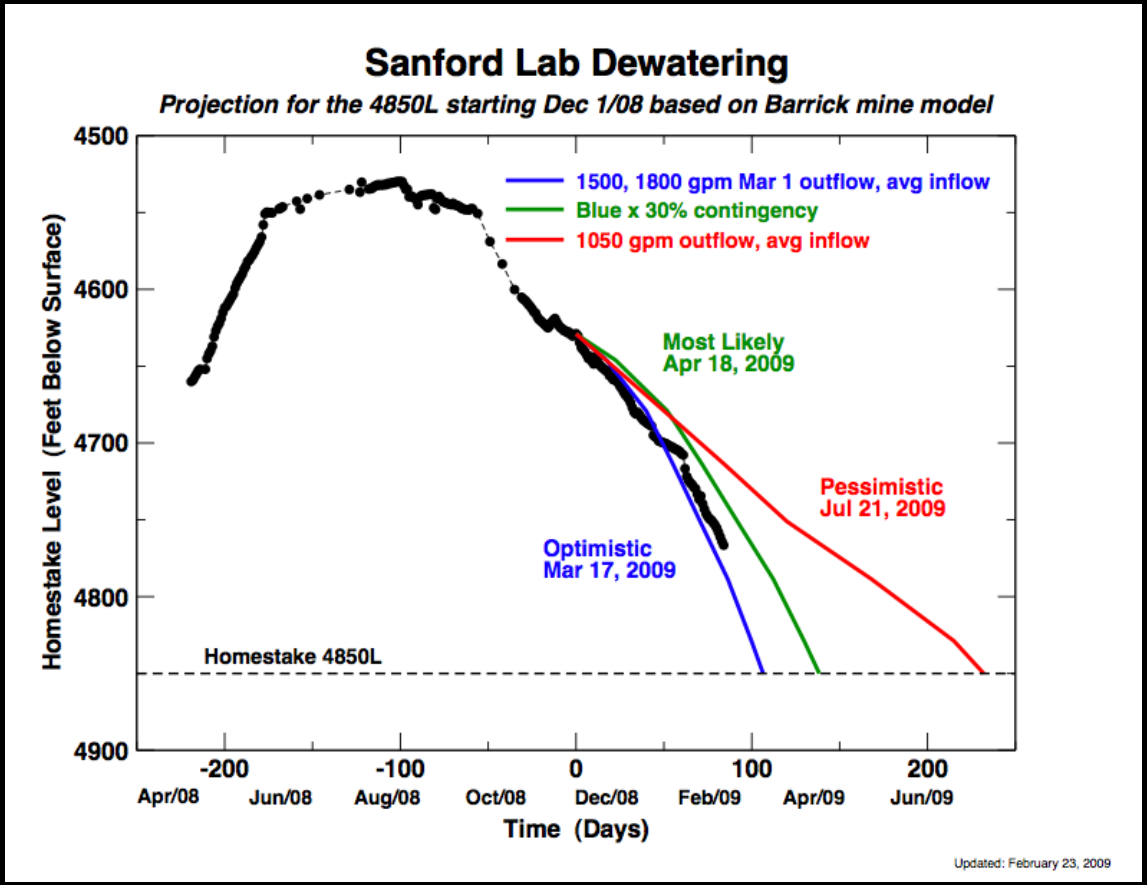
Submersible Pumps on 3950L

Piping from 4250L into 3950L Tank

4550L Submersible Pumps in Action

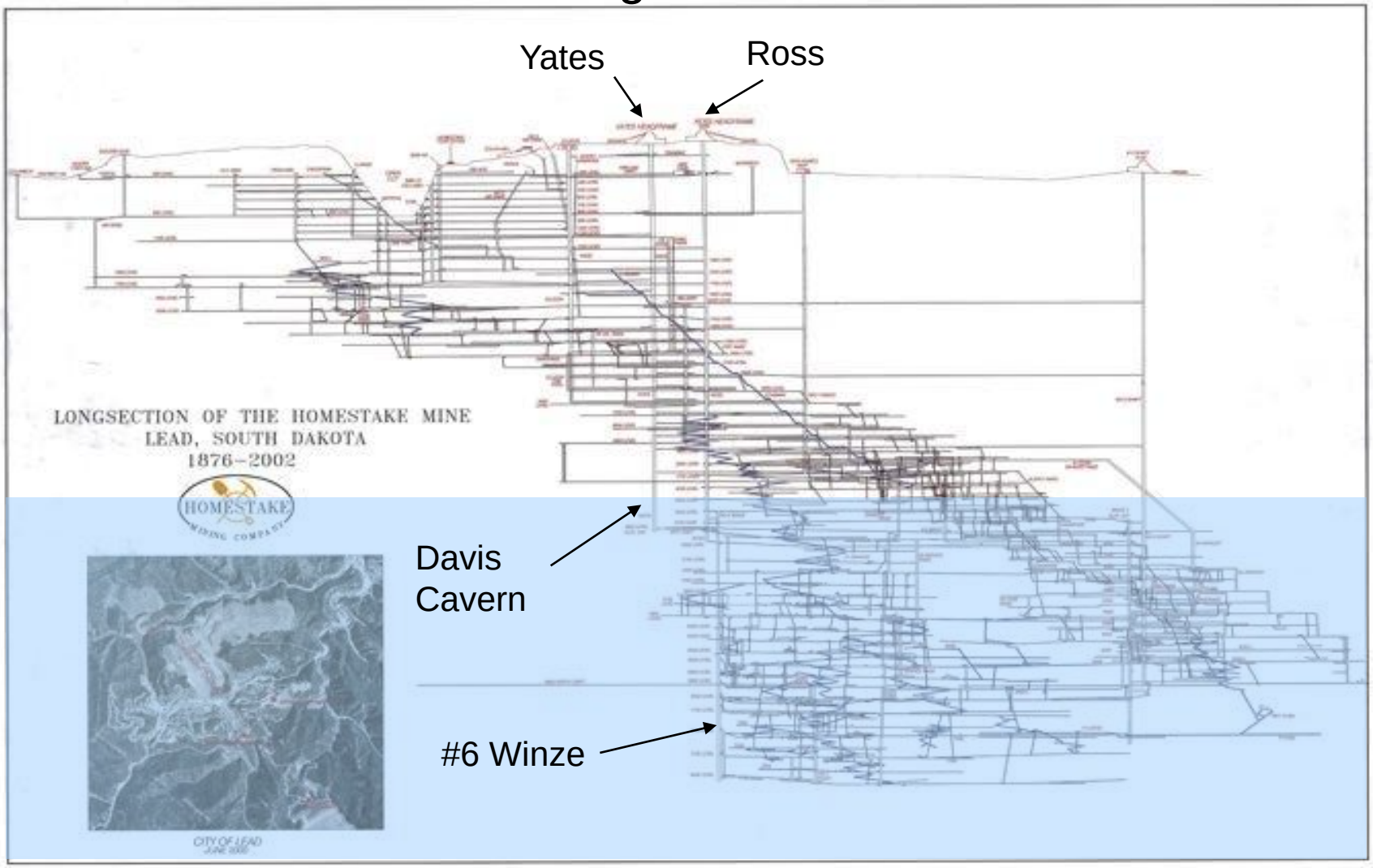


Making progress!



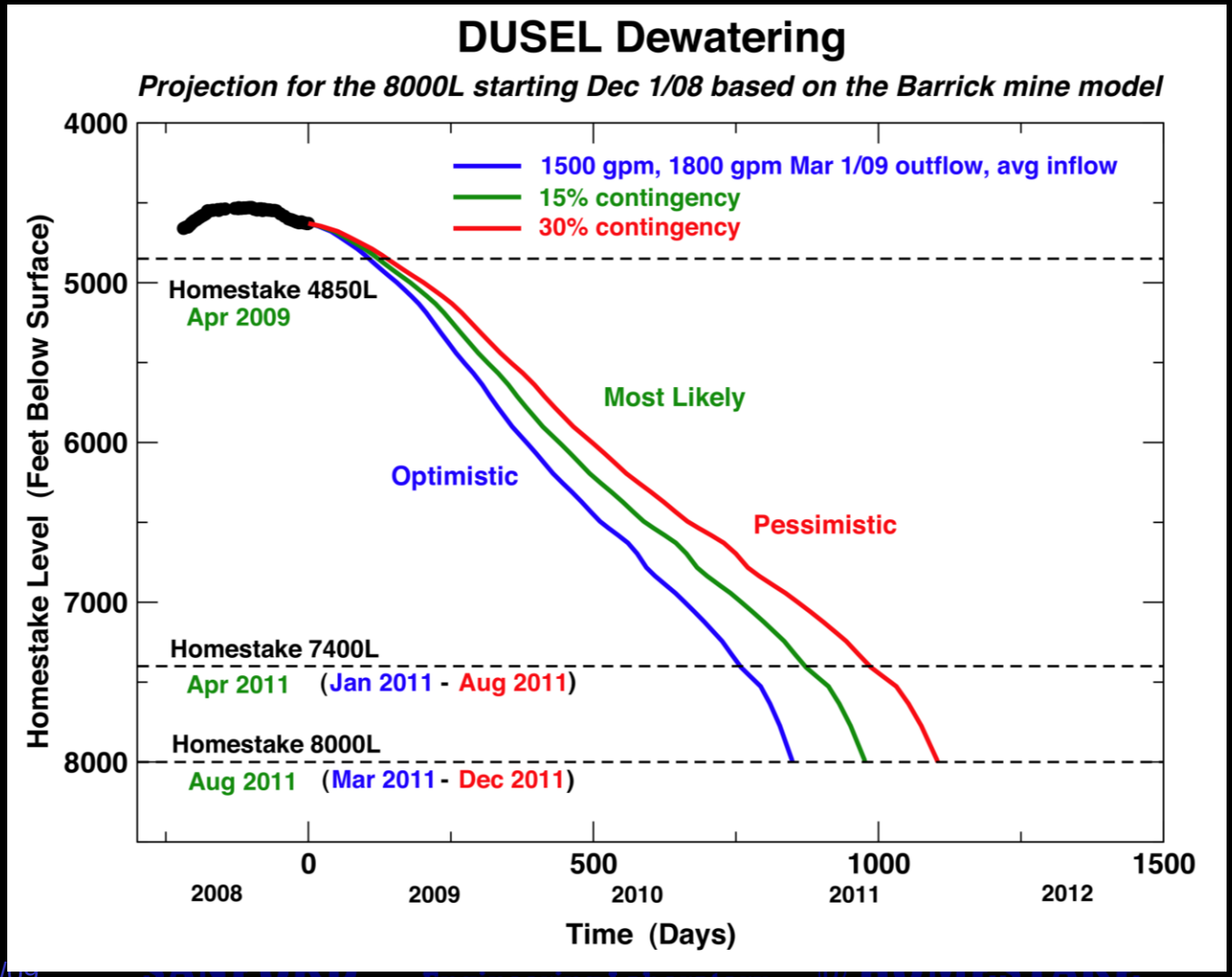
Water level 2/26 …… 4775 (feet below surface)

Draining the Mine



"Deep Six" Project:
1500 gpm well pump at base of #6 Winze

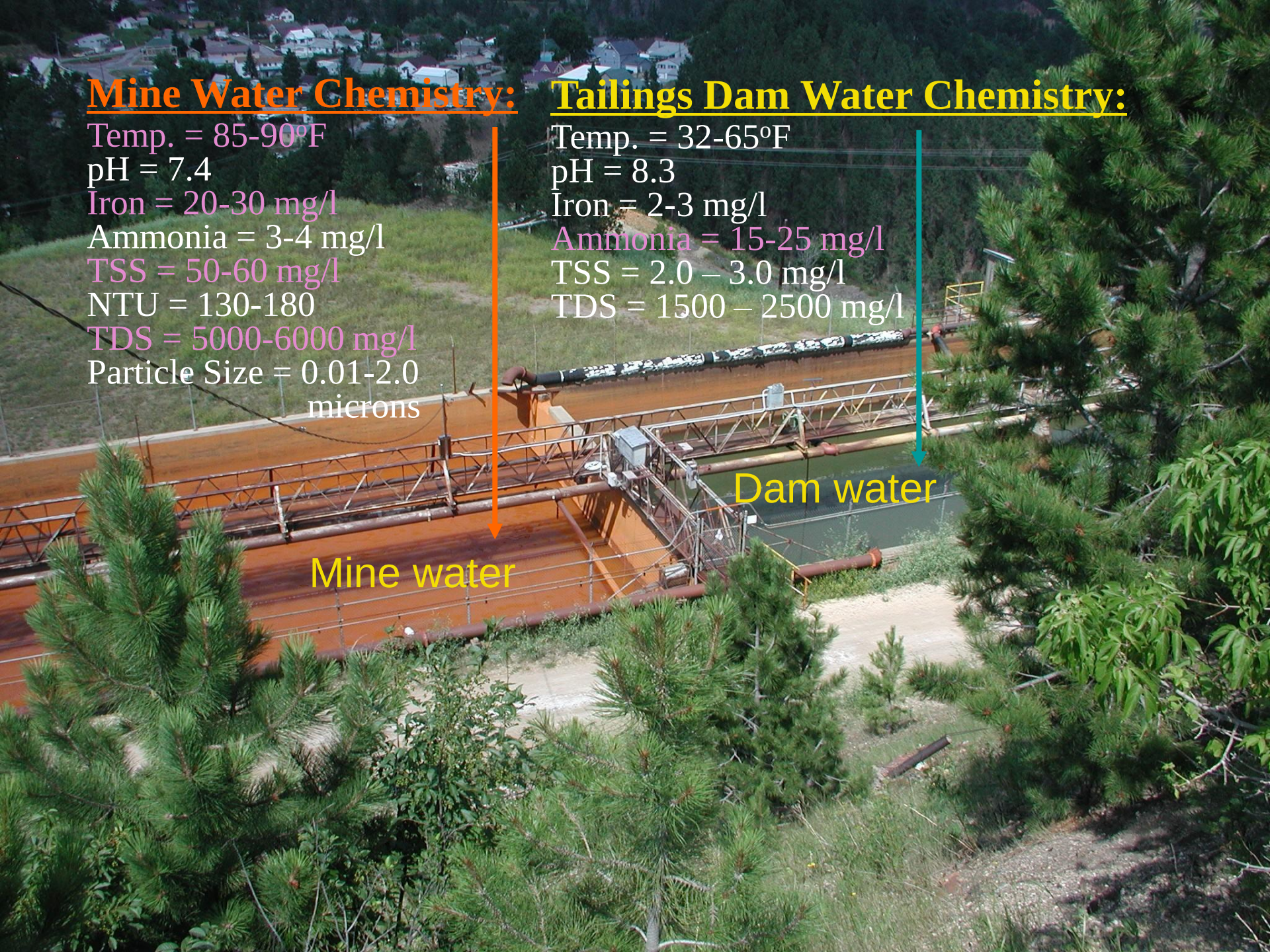
Plans for a DRY MINE



Not only water… it's what' in it!

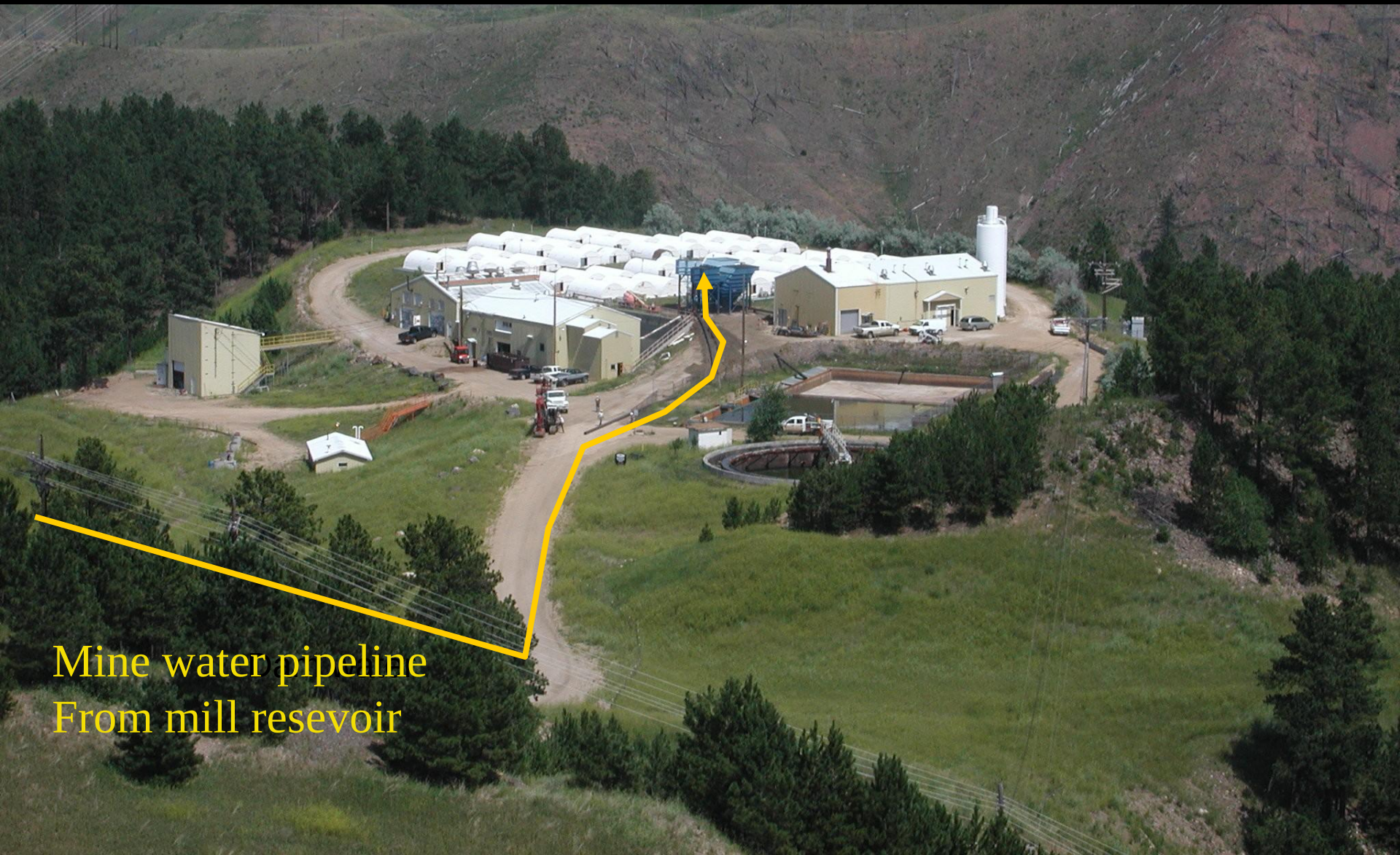
Pooled water has leached minerals from rocks

Iron oxide must be removed!

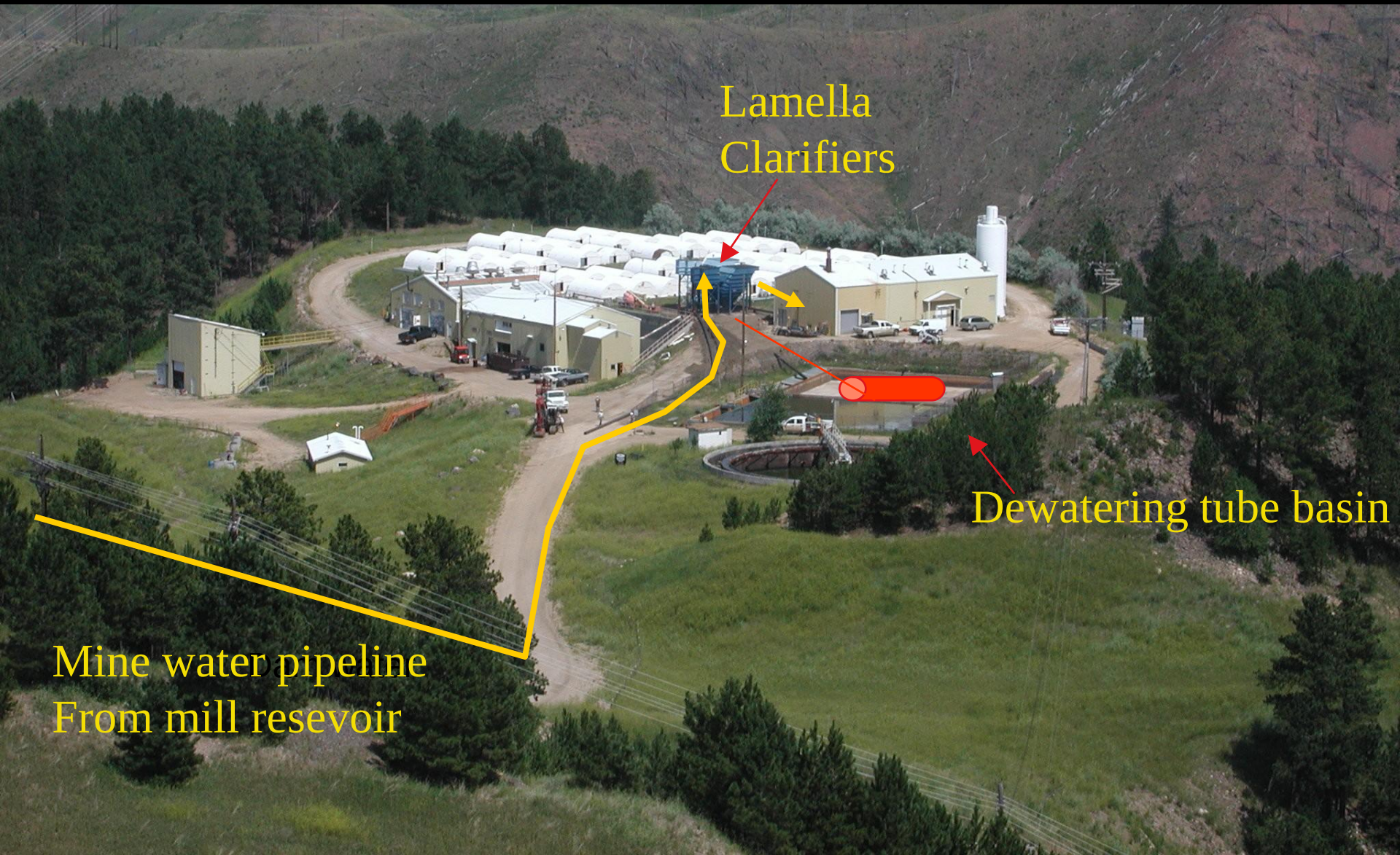

Mine Water Chemistry:
Temp. = 85-90ºF
pH = 7.4
Iron = 20-30 mg/l
Ammonia = 3-4 mg/l
TSS = 50-60 mg/l
NTU = 130-180
TDS = 5000-6000 mg/l
Particle Size = 0.01-2.0 microns
Mine water
Tailings Dam Water Chemistry:
Temp. = 32-65ºF
pH = 8.3
Iron = 2-3 mg/l
Ammonia = 15-25 mg/l
TSS = 2.0 – 3.0 mg/l
TDS = 1500 – 2500 mg/l
Dam water

Homestake Water Treatment Plant
Back in Service

Homestake Water Treatment Plant
Back in Service



Homestake Water Treatment Plant
Back in Service




Lamella clarifiers

Lamella Clarifiers

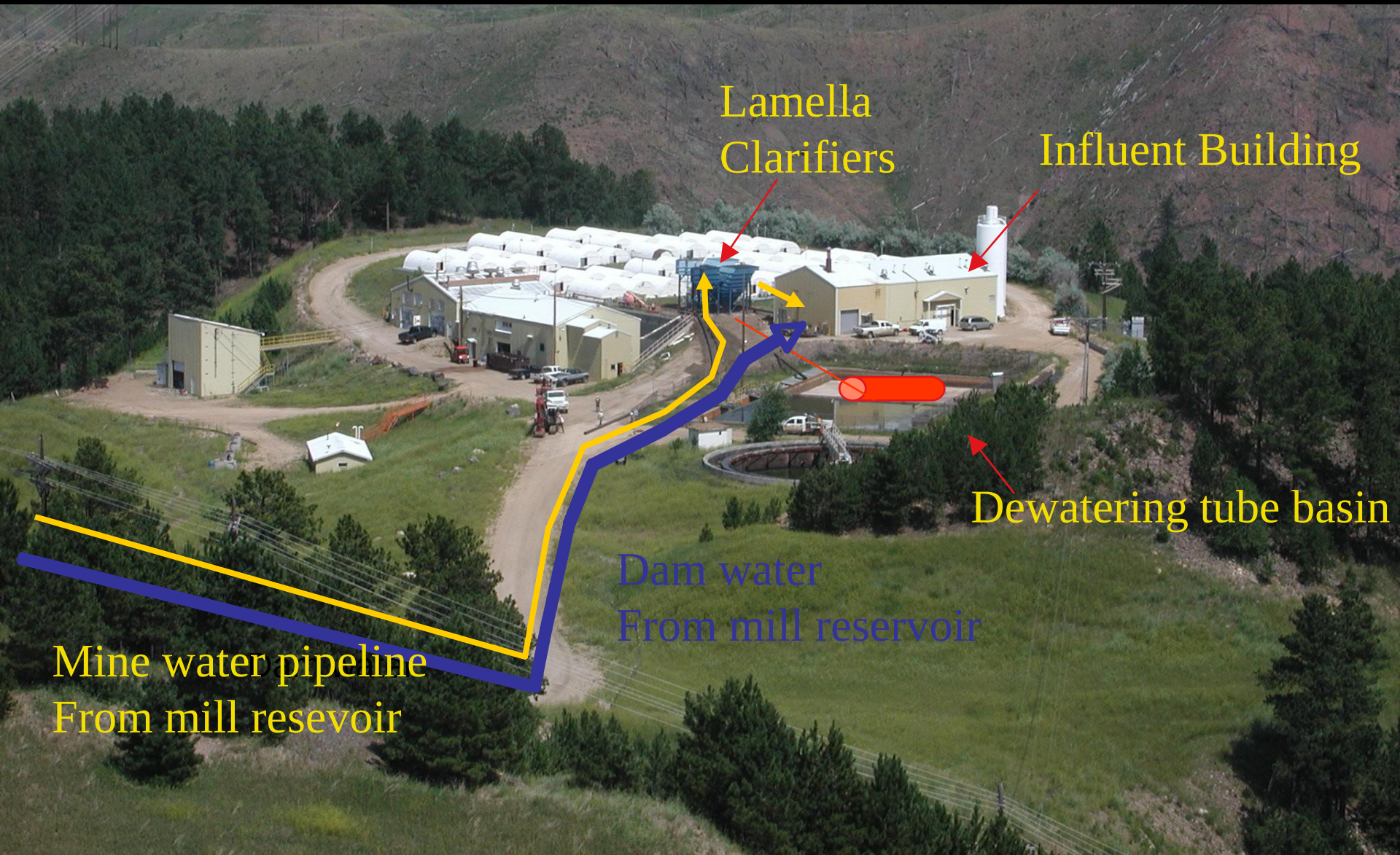
Coagulant polymers
and flocculants
aid precipitation
of iron


“Geotubes” collect
Fe sludge
(~ 2T/day)

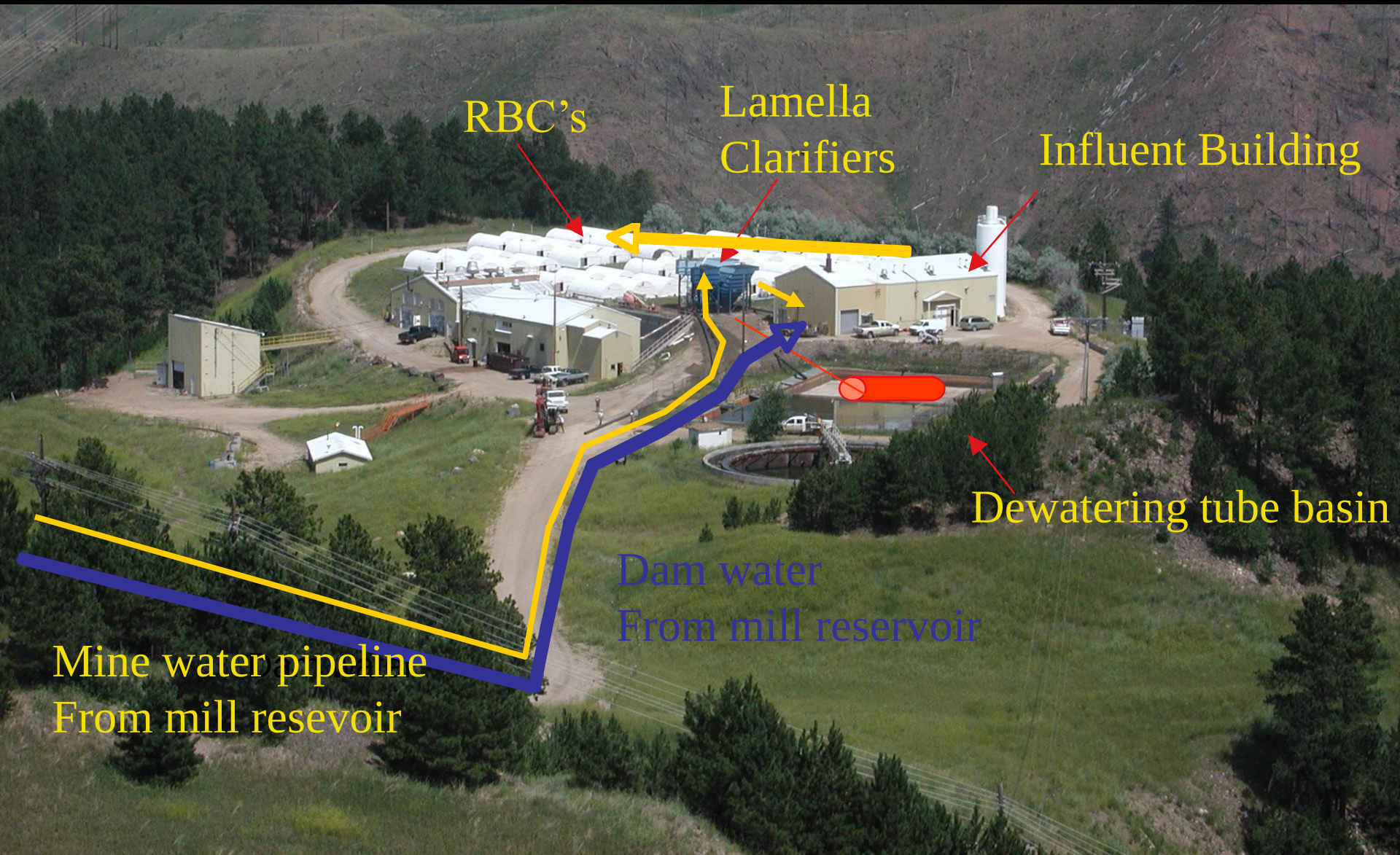
Higher Efficiency Fe Removal

2000 gpm
Sand filters

Homestake Water Treatment Plant
Back in Service

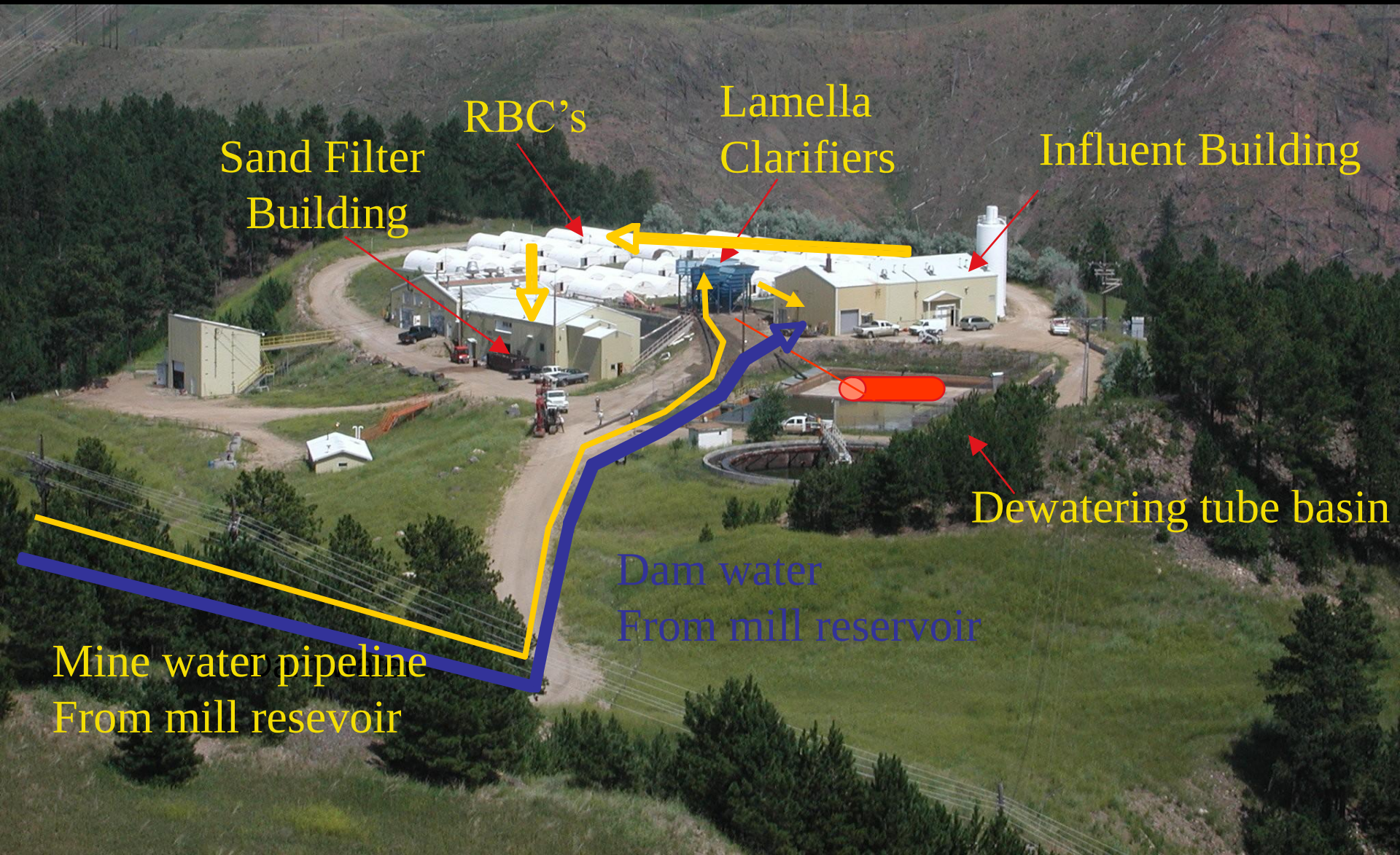


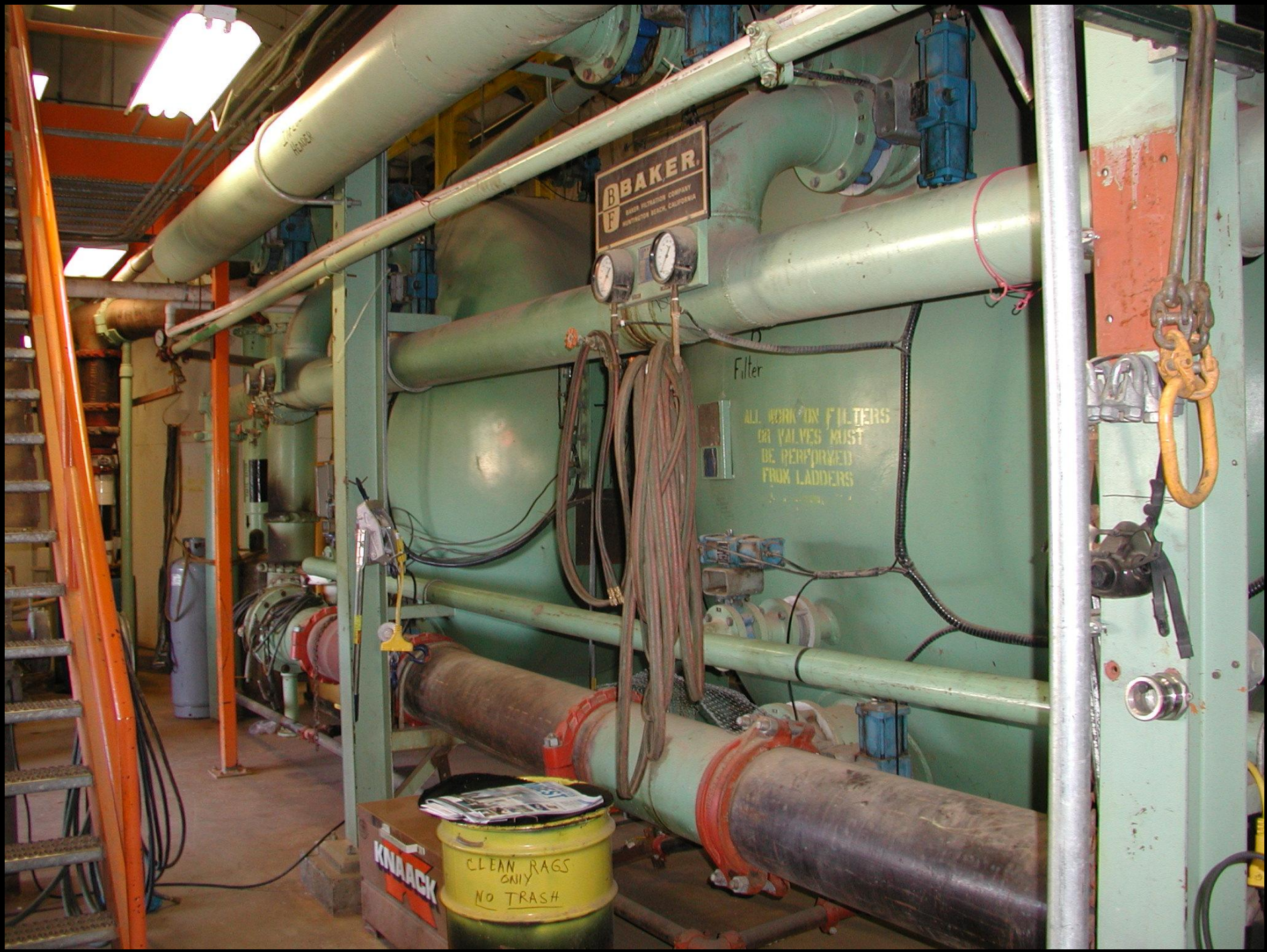
Homestake Water Treatment Plant
Back in Service



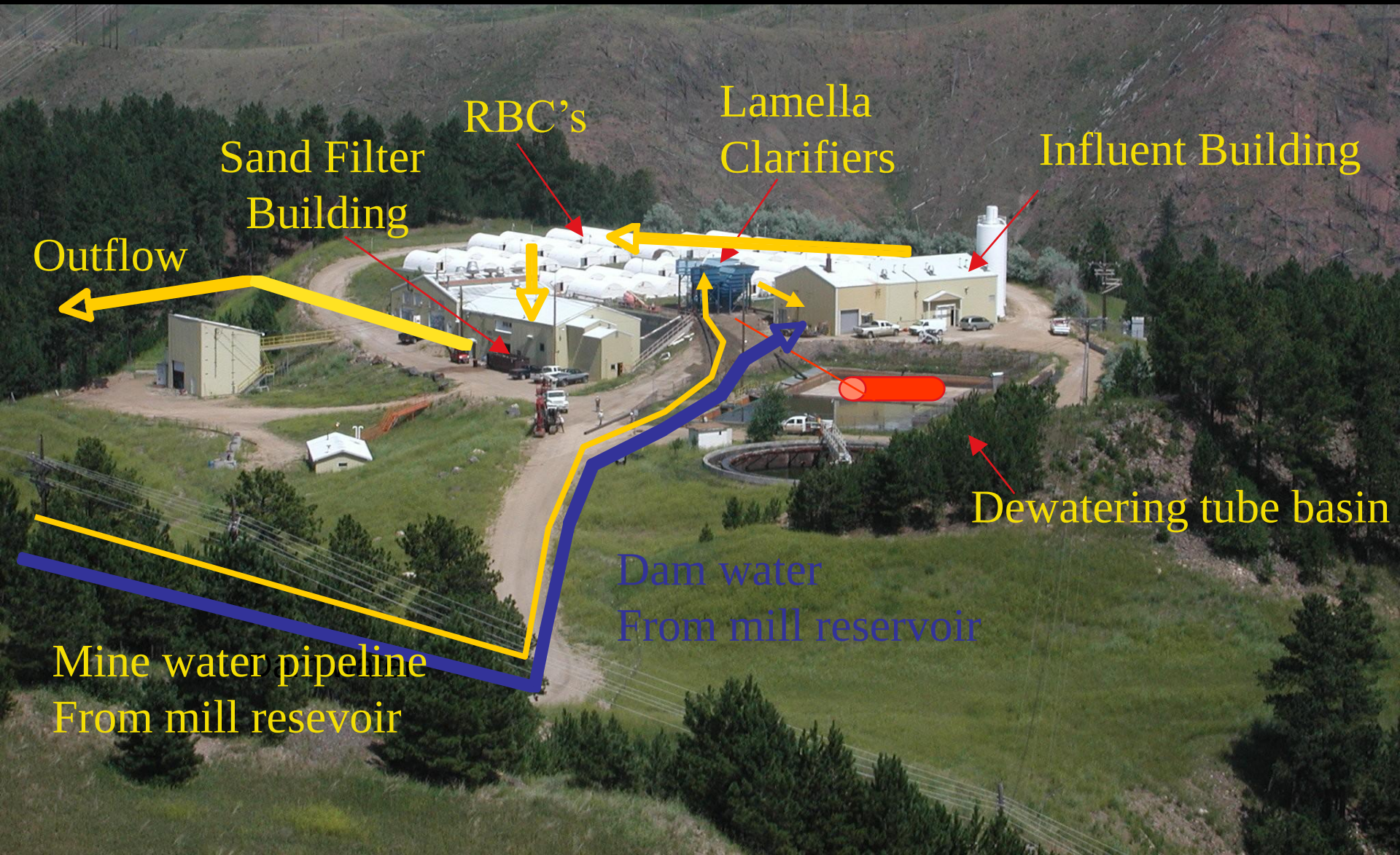
RBC's (Rotating Biological Contactors) remove Ammonia

Homestake Water Treatment Plant
Back in Service

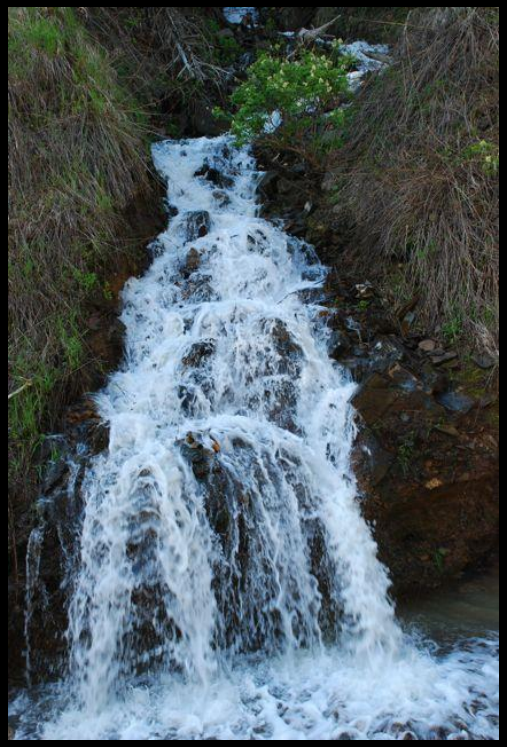



BAKER
Filter
ALL WORK ON FILTERS
OR VALVES MUST
BE PERFORMED
FROM LADDERS
KNAACK
CLEAN RAGS
ONLY
NO TRASH

Homestake Water Treatment Plant
Back in Service

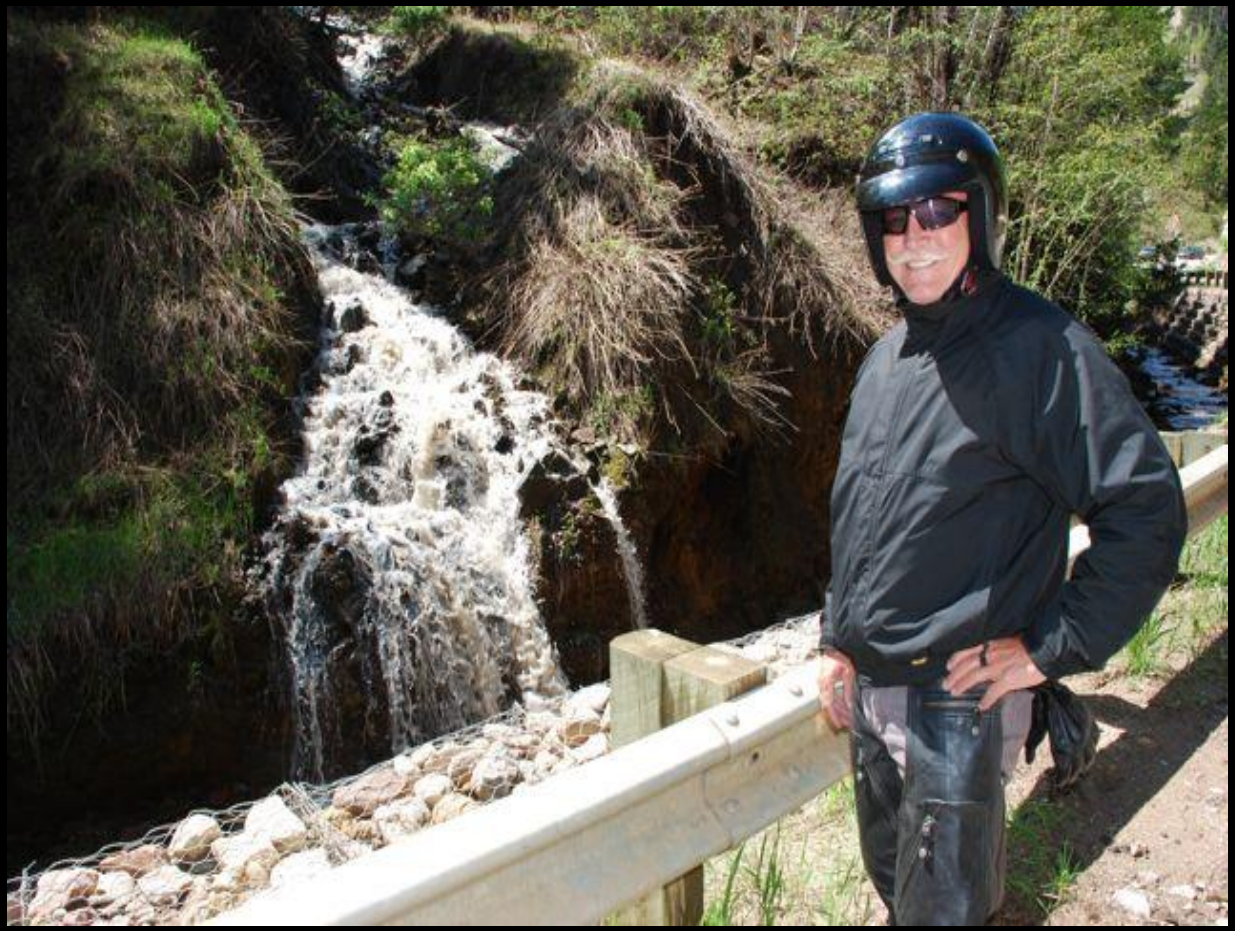


Homestake Waterfall Back in Business



Fish are happy

So are the Tourists



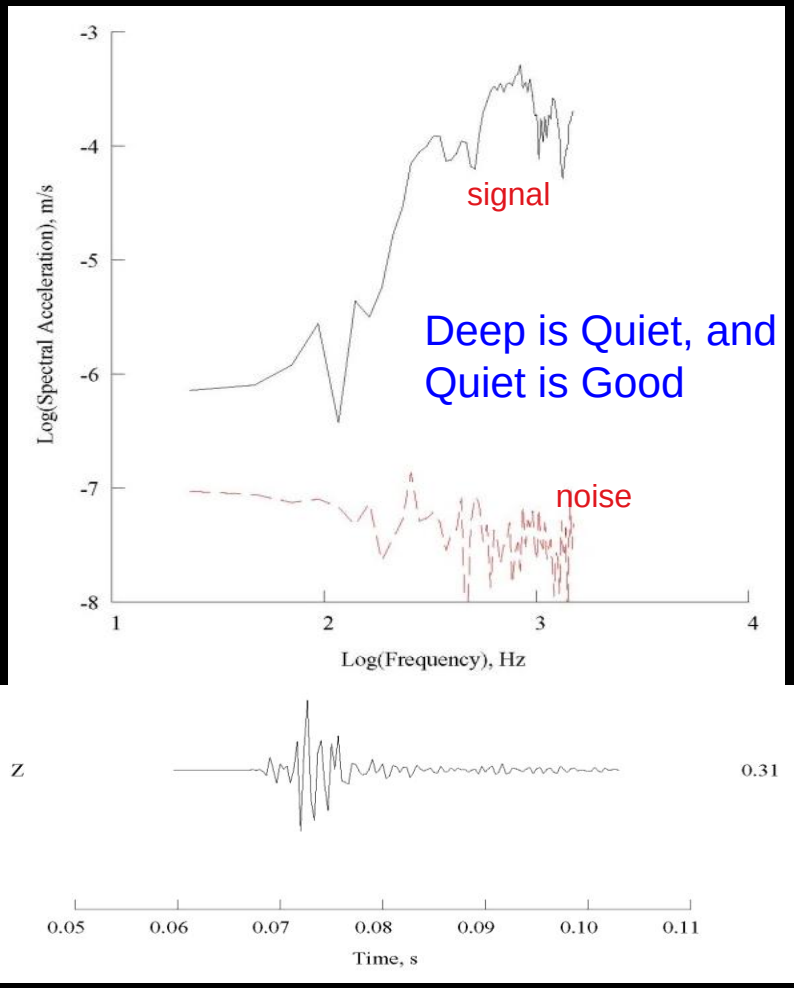
“Early Science” Progress

- Presently ongoing
  - Geophysics/Hydrology
  - Microbiology
- Plans maturing
  - LUX
  - MAJORANA

Towards a Transparent Earth

S.D. Glaser, *UC, Berkeley*
W. Roggenthen, *SDSMT*
L.R. Johnson, E.L. Majer, *LBNL*

Install an acoustic "microscope" surrounding the Homestake workings –
1st NSF funded DUSEL research

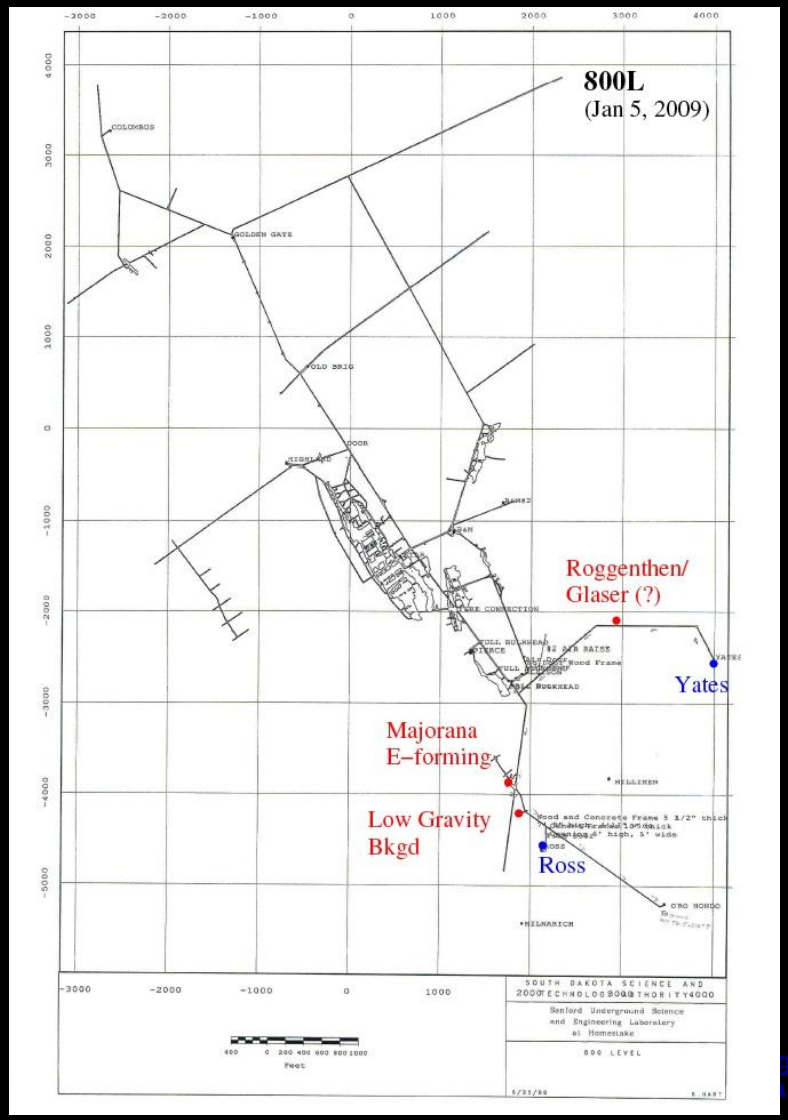


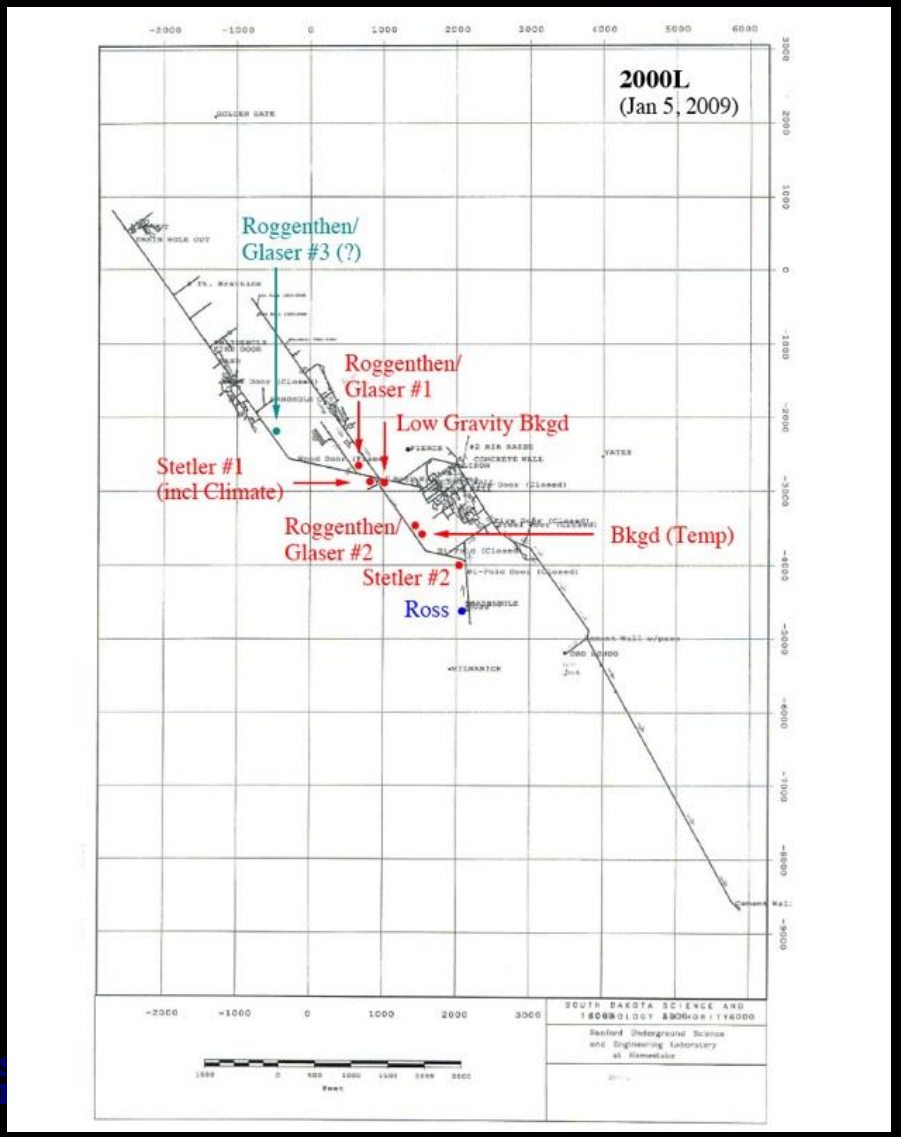
1) Develop deep in-situ seismic observatory for rapid imaging of dynamical geo-processes at depth.
2) Provide rock mass dynamics and safety information to miners and tunnelers
3) Provide an infrastructure for all earth scientists
4) Improve ability to detect and characterize underground structures and activity

More Geophysics Research

- LIGO seismometer stations
  - 300, 800, 2000, {4100}
- Tiltmeter installations
  - SDSMT/FNAL
- Hydrometry
  - Sampling #6 Winze
    - 4550 to 8000

Deployments at 800 L and 2000 L





Microbiology

Cynthia Anderson (Black Hills State) samples “interesting” fungus at 2000 L

1st Sanford Lab Publication!

Isolation and characterization of cellulose-degrading bacteria from the deep subsurface of the Homestake gold mine, Lead, South Dakota, USA

Gurdeep Rastogi[1], Geetha L. Muppidi[1], Raghu N. Gurram[1], Akash Adhikari[1], Kenneth M. Bischoff[2], Stephen R. Hughes[2], William A. Apel[3], Sookie S. Bang[1], David J. Dixon[1], Rajesh K. Sani[1] ([1]-SDSMT, [2]-USDA, [3]-INL)

Site Characterization starts

Radon monitoring

Natural radioactivity measurements

DongMing Mei (USD)

U/Th/K Assays

- Poorman/Yates

U	0.08 ppm	0.03 pCi/gm
Th	0.2 ppm	0.02 pCi/gm
K	0.1 pct	0.84 pCi/gm

- Rhyolite

U	9 ppm	3.1 pCi/gm
Th	12 ppm	1.3 pCi/gm
K	3 pct	25 pCi/gm

(Al Smith, LBNL)

4850 Geology

Yates member, Poorman formation
Poorman formation
Tertiary intrusions (Rhyolite)

Davis Chamber

Yates Shaft

250 m

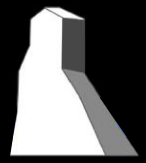
11537

11553

Major "Early" Physics Experiments

- LUX: Dark Matter search
  - Liquid Xenon TPC
  - To be deployed in Davis Cavern 4850 L

- MAJORANA "Demonstrator": $0\nu\beta\beta$
  - E-forming lab 800L (present plan)
  - Counting lab at 4850 L

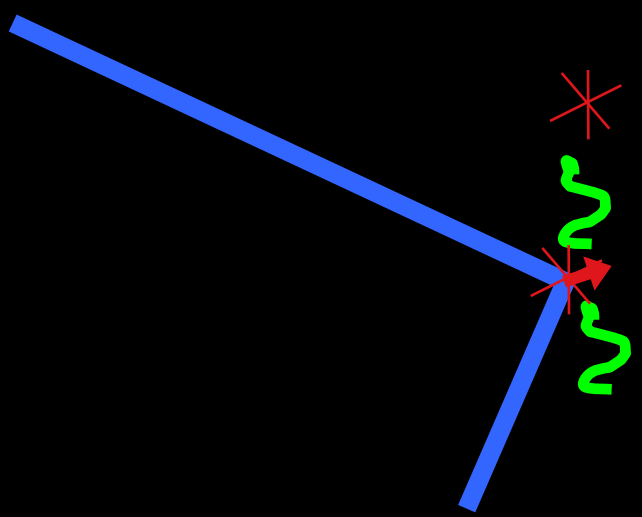


LUX:
Large Underground Xenon Experiment

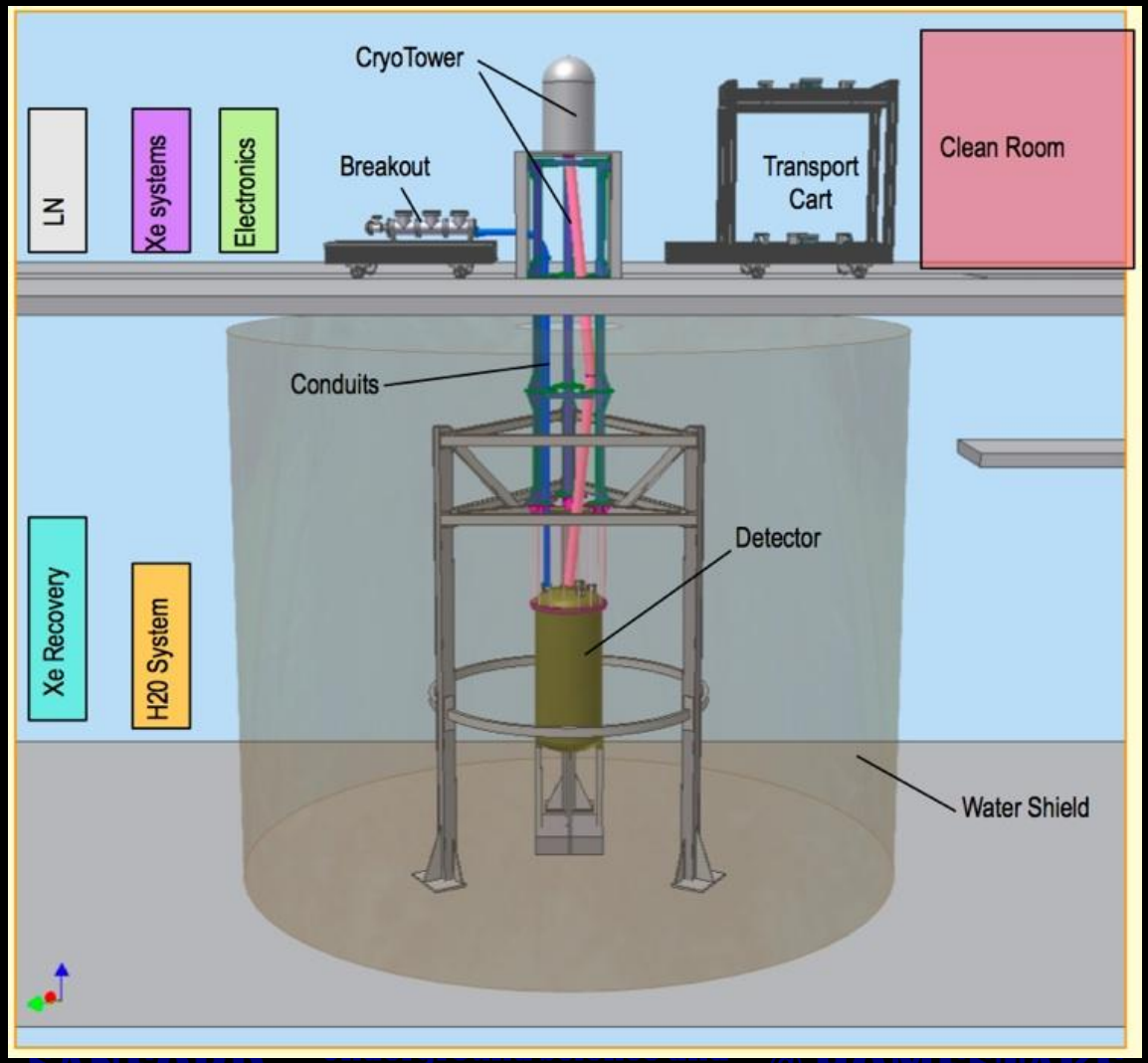
- TPC-based noble liquid detector
  - 350 kg liquid xenon TPC
    (Time Projection Chamber)
  - Deployed in 8 meter diameter water tank
  - 4850 Level, “Davis” chamber
- Principals:
  - Richard Gaitskell, Brown University
  - Tom Shutt, Case Western Reserve
  - CNA Consulting, Lee Petersen

LUX cryostat

- 350 kg LXe
- 2-phase
- TPC configuration
- PMTs above/below
- High voltage grids



LUX Deployed in 4850 Davis Cavern

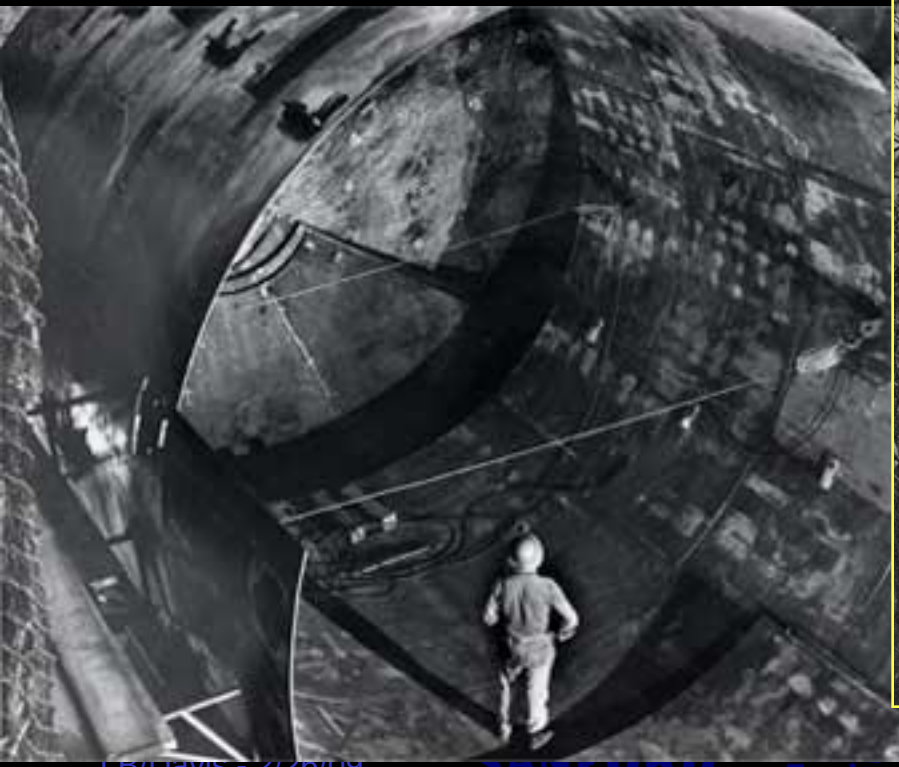


Prototype Cryostat

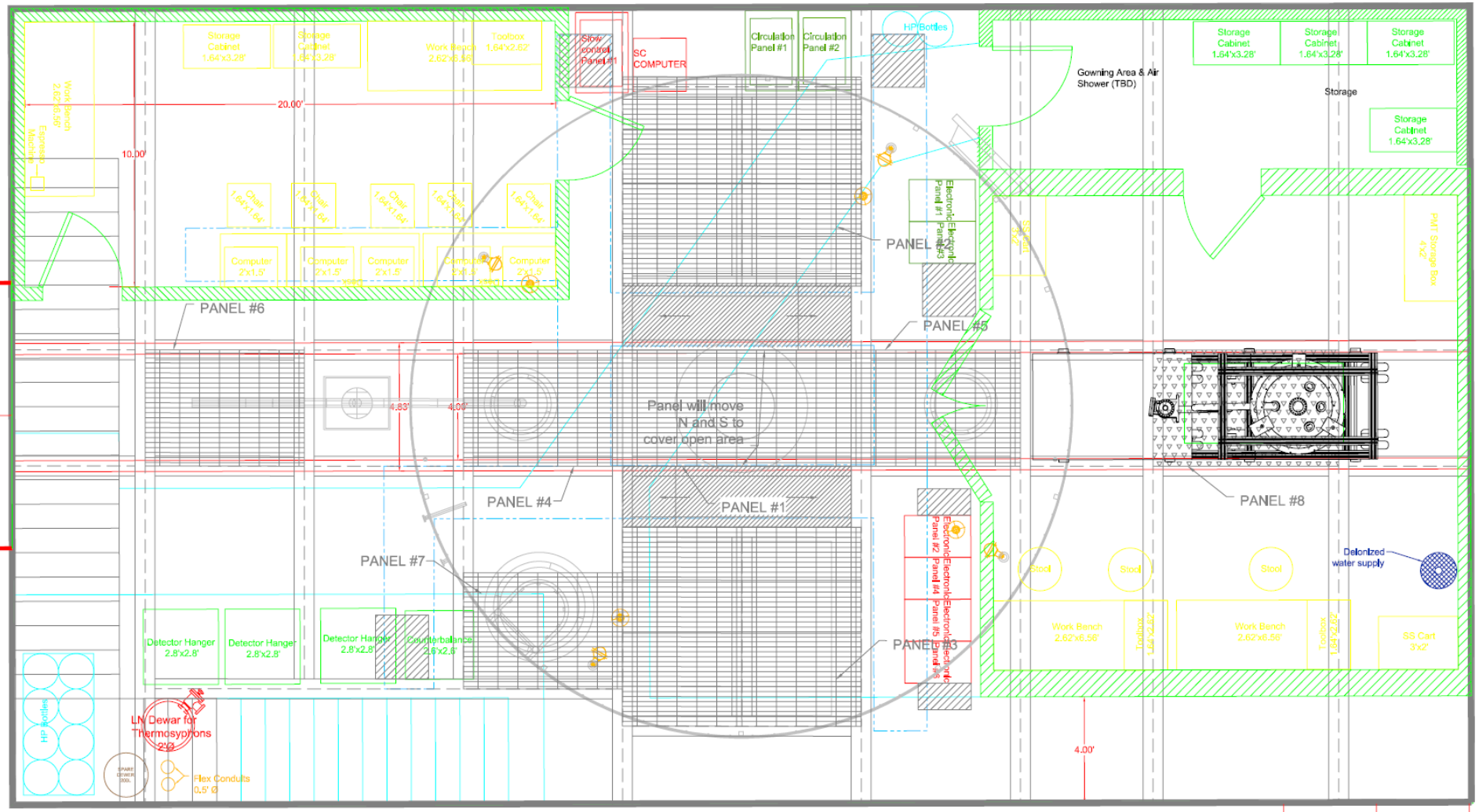
- Case Western
  - Stainless
  - Full size can
  - small detector
  - (50 kg)

Davis Cavern

1965
solar ν experiment
100,000 gal cleaning fluid

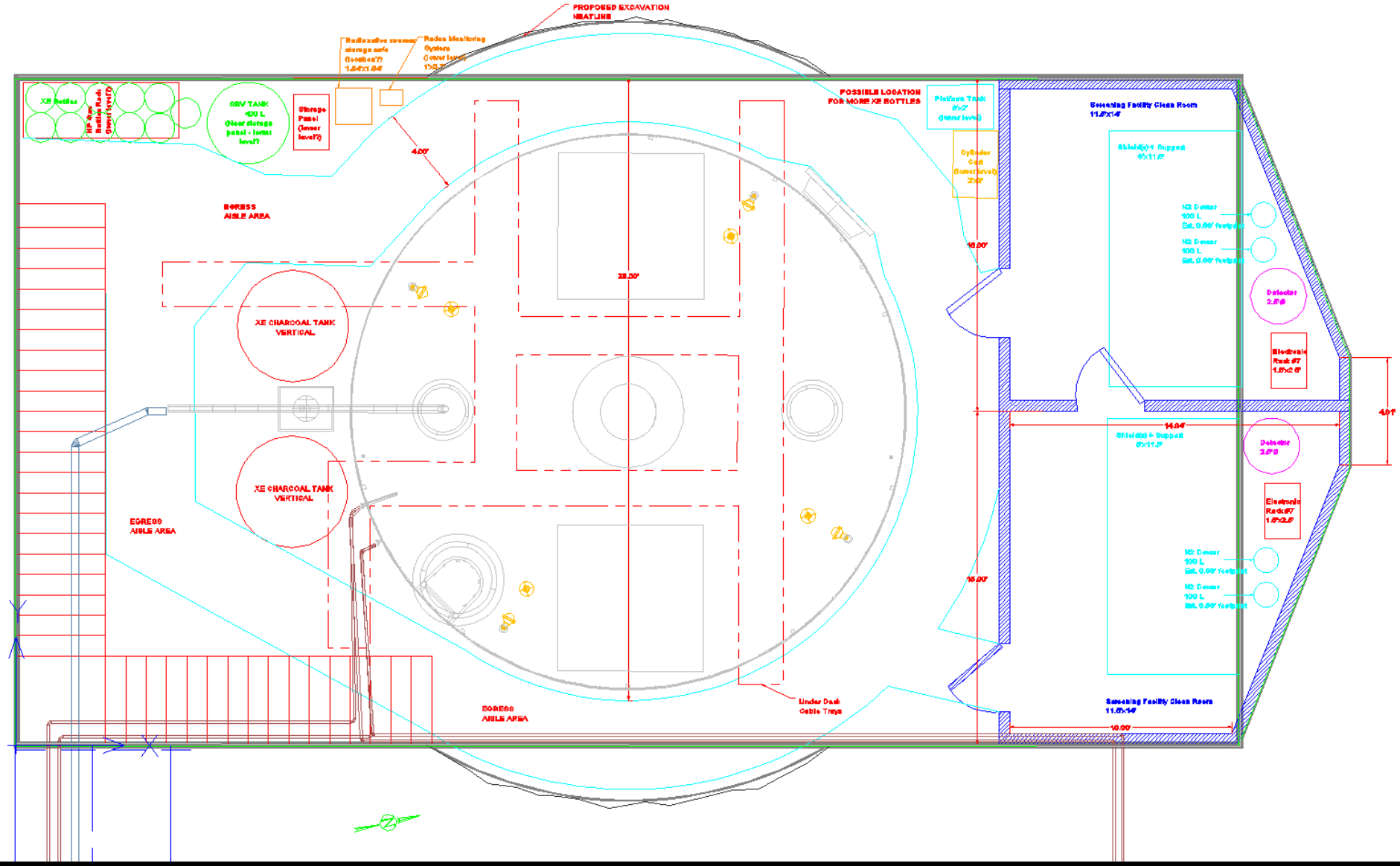


Upper Level Floor Plan

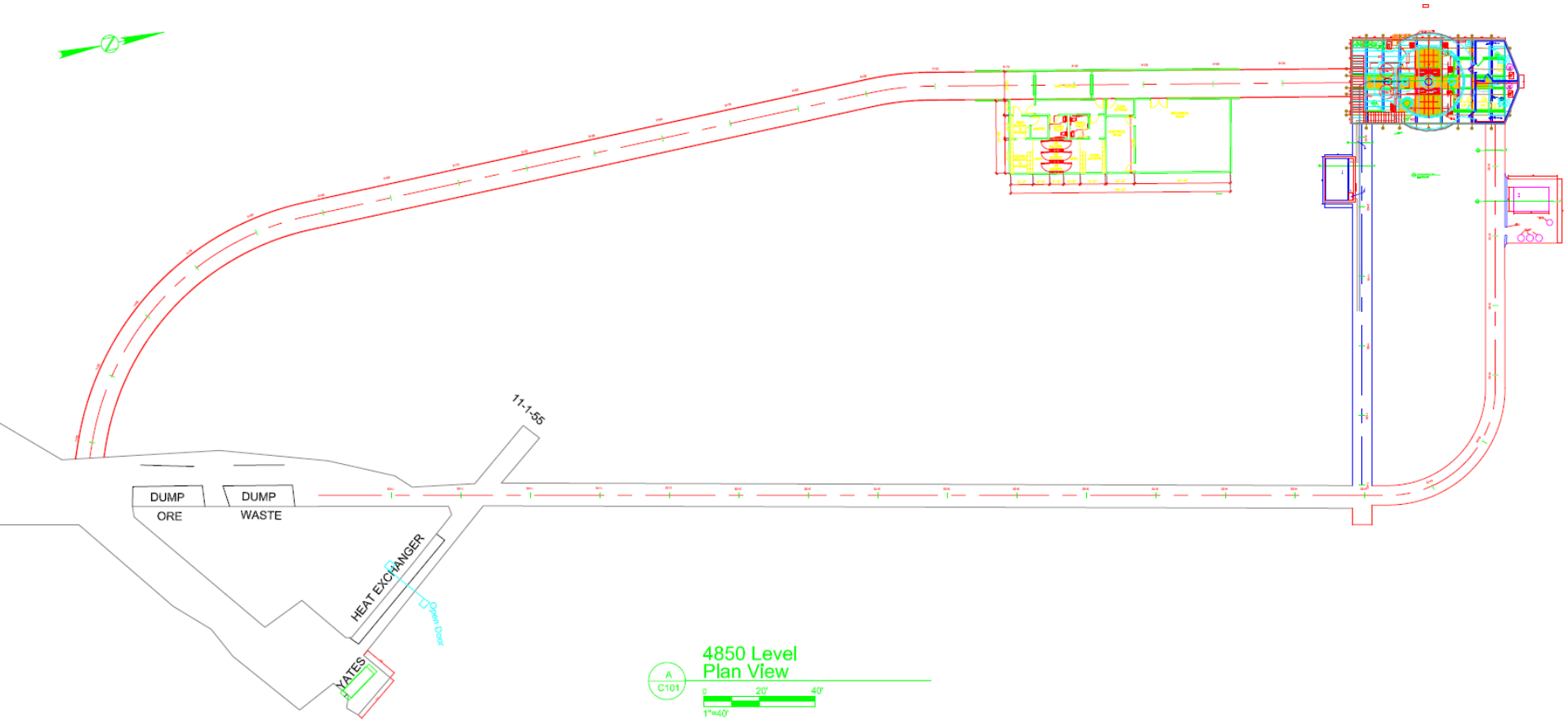


Plans: CNA Engineering, Minneapolis... Lee Petersen

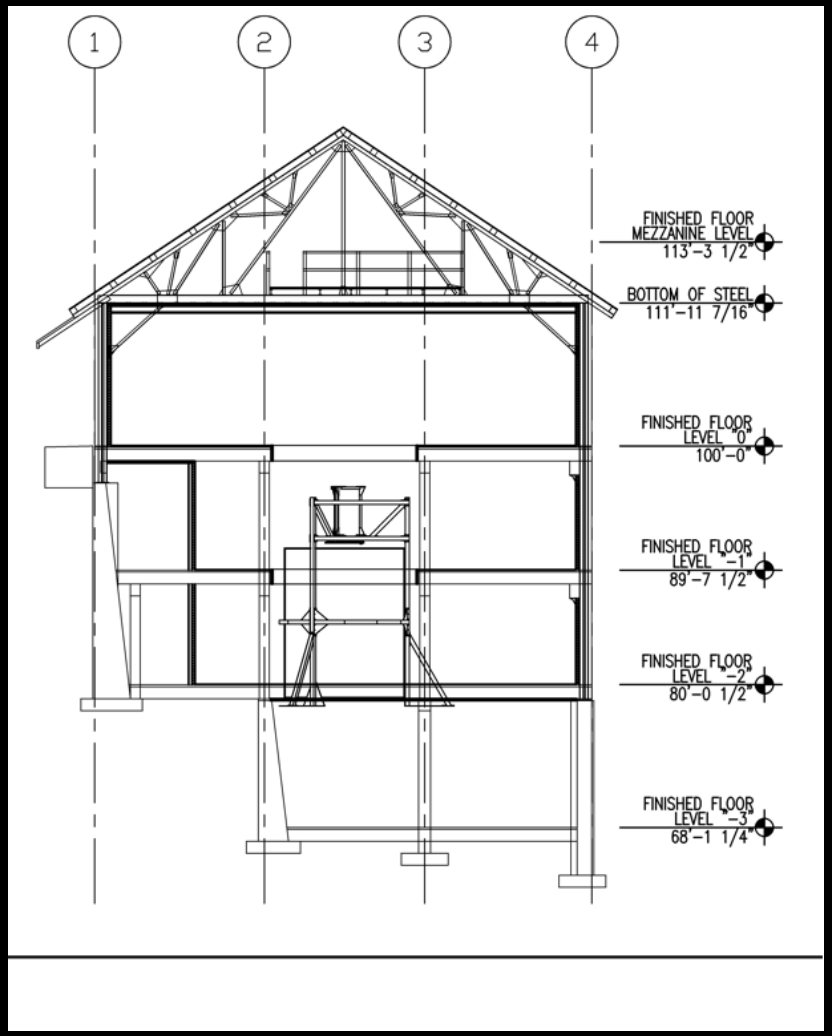
Lower Level Floor Plan

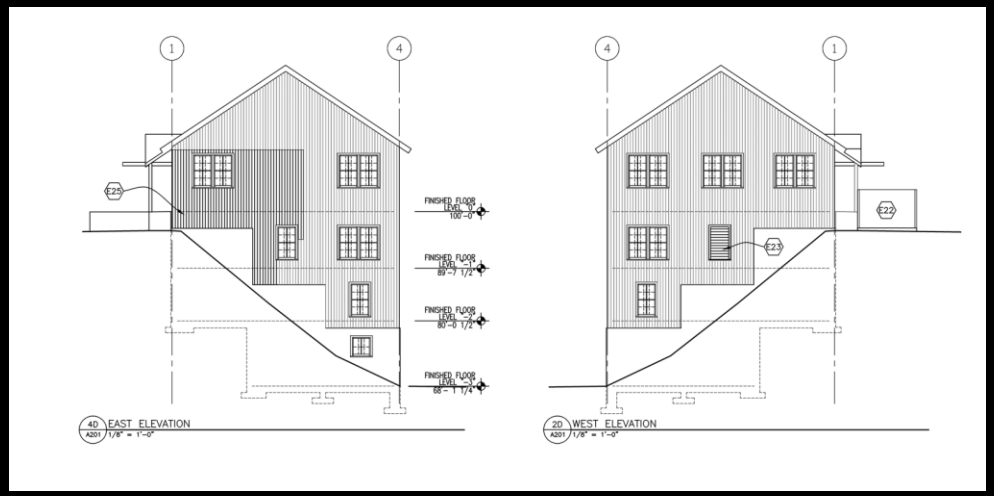


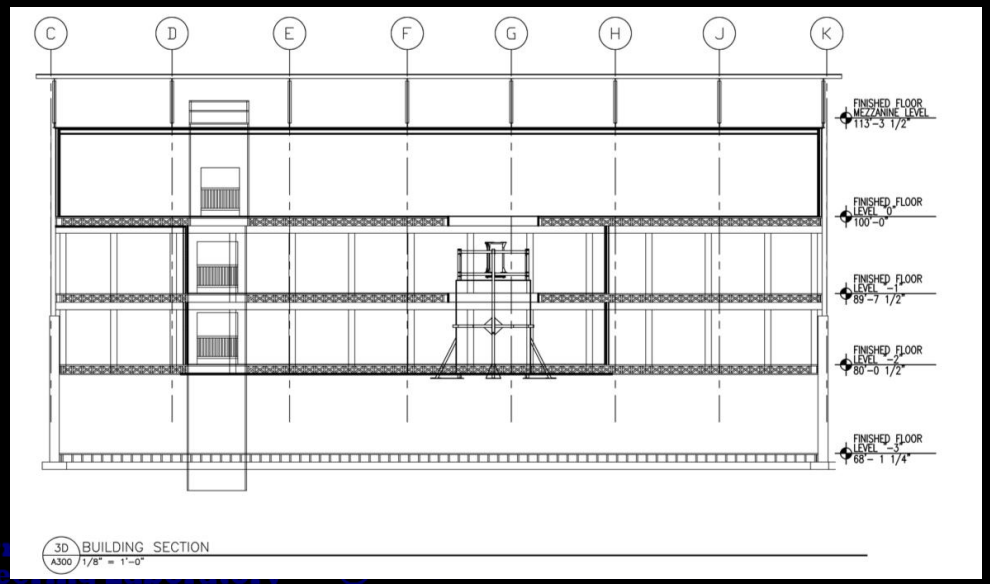
LUX Plan View, Dec 08



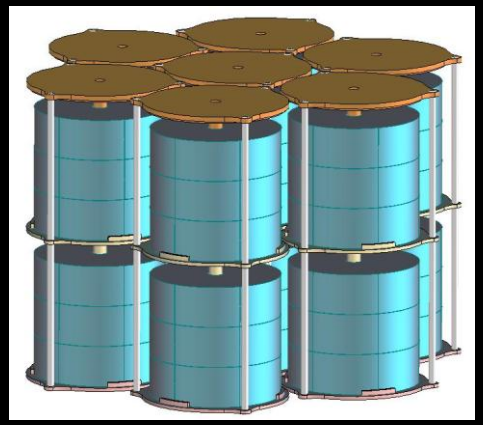
Building Elevations & Sections… Warehouse

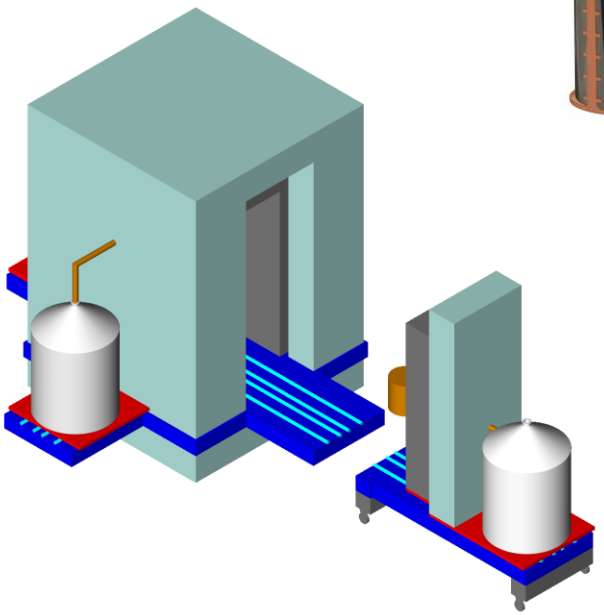






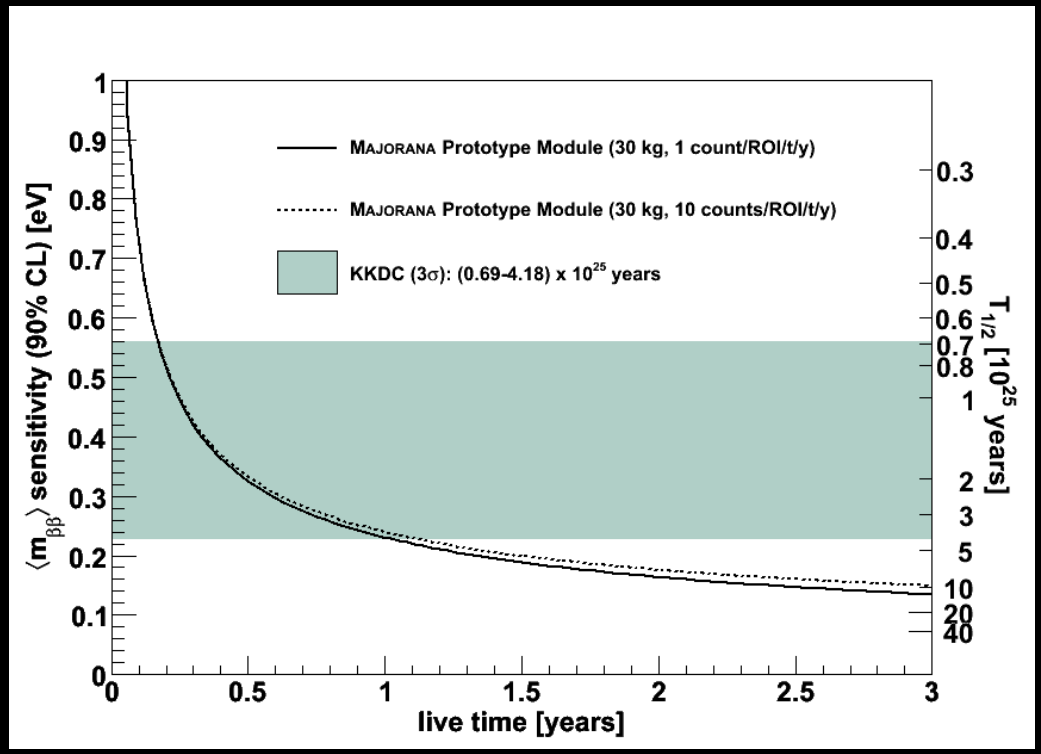
MAJORANA: ^{76}Ge 0νββ -decay





January 2009

John Wilkerson



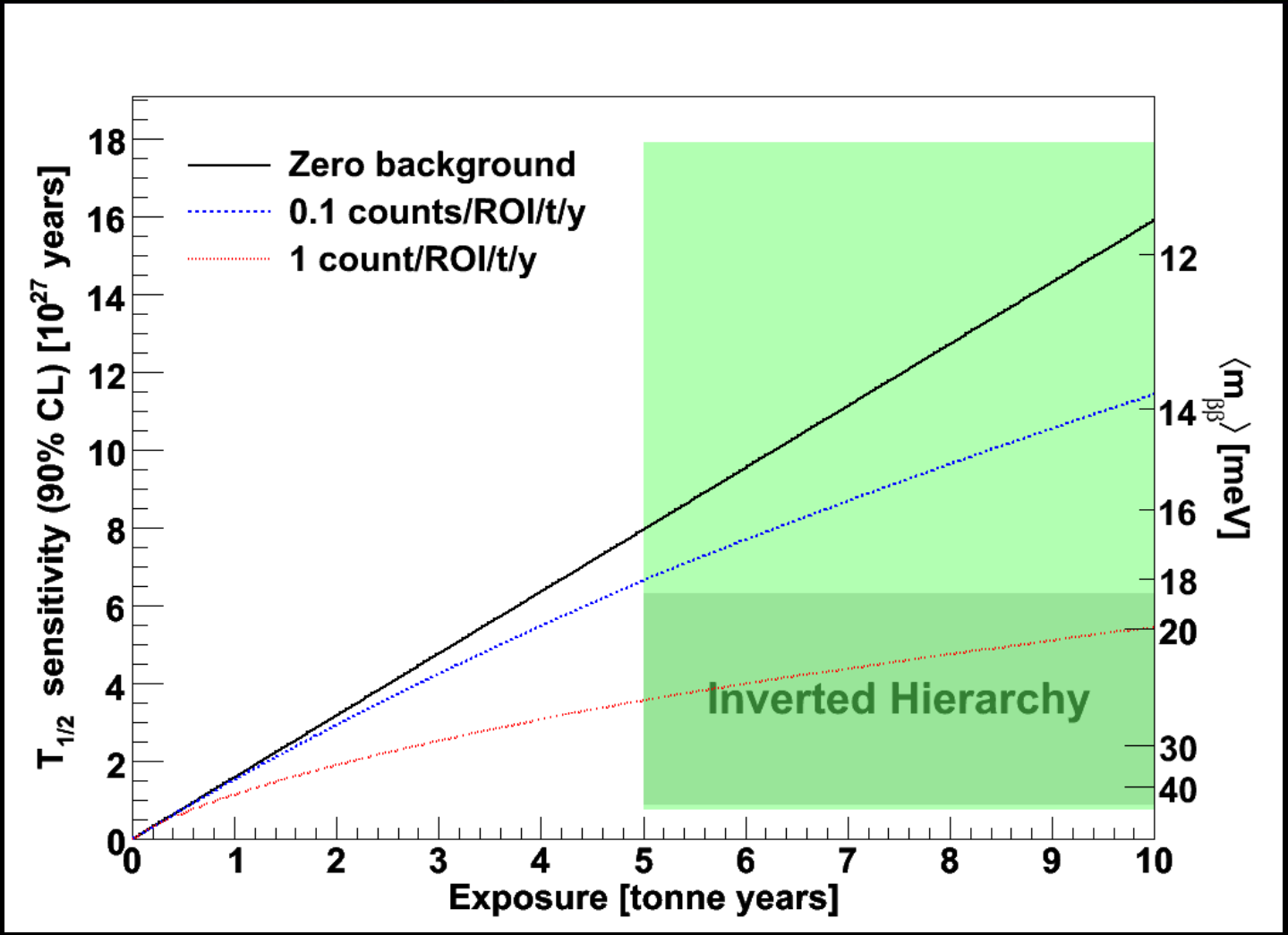
A 1-tonne ^{76}Ge Experiment

The MAJORANA collaboration is currently pursuing R&D aimed at a ~1 tonne scale ^{76}Ge 0ν-decay experiment that would be one of the flagship Suite of Experiments to be sited at DUSEL Homestake.

1-tonne Science goals:

- Determine the nature of the neutrino, Majorana or Dirac.
- Test the fundamental symmetry of lepton number conservation.
- Probe absolute neutrino mass at a sensitivity of 20-40 meV.
- Seek to understand the origin of particle masses.
- Search for Dark Matter candidates.

1-tonne Ge - Projected Sensitivity vs. Background

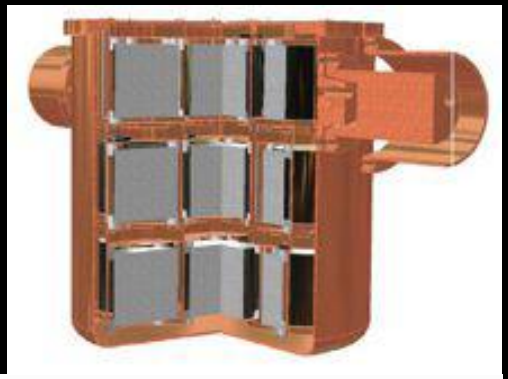


Goal is to achieve ultra-low backgrounds of less than 1 count per ton of material per year in the Region of Interest (ROI) about the $\beta\beta(0\nu)$ Q-value energy (~4 keV at 2039 keV).

The MAJORANA Demonstrator Module

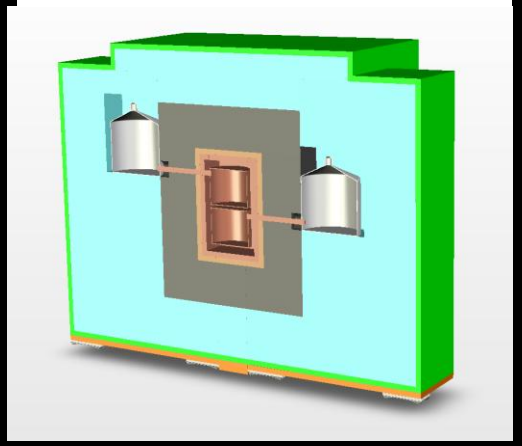
PLANS for Early Science deployment

Low background cryostats and shields
- Develop electroforming techniques in underground environment
- Ultra clean assembly techniques

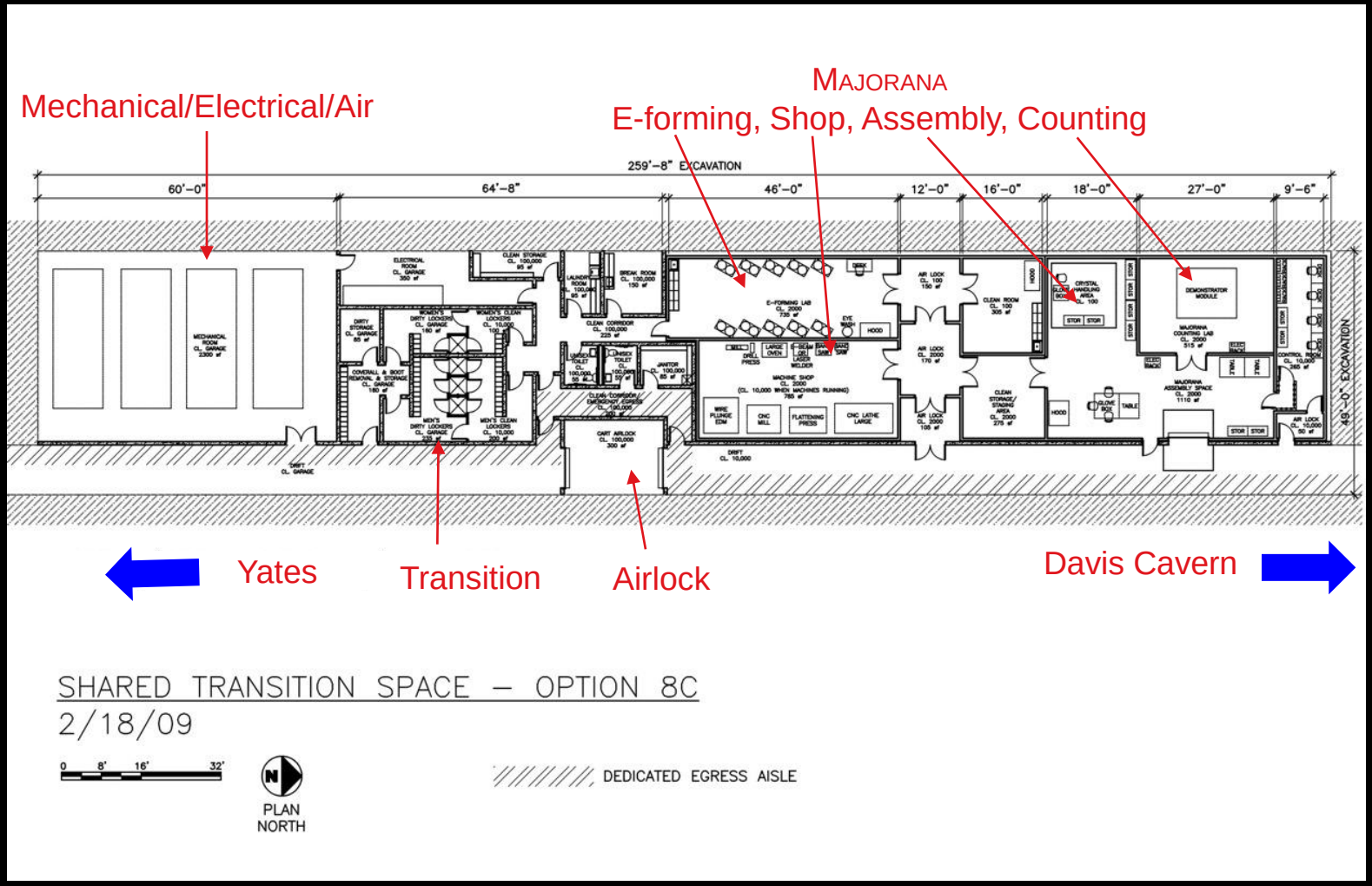


60 kg Ge (50% enriched ^{76}Ge)
- Crystal growth, detector manufacture

Deployment underground at Sanford Lab
- Electroforming lab at 800 L
- Assembly and counting area at 4850 L



New Drift Transition Space, with MAJORANA



Deployment

LUX

- Early Summer 2009
  - Surface Warehouse
- Late Fall 2009
  - 4850 L Davis Cavern

MAJORANA

- Early winter 2009

Summary

- Great progress in re-entry/de-watering
- Robust Early Science program underway
- Developing infrastructure of value to DUSEL
  - Davis cavern environmental systems and water tank suitable for next generation Dark Matter experiment
  - E-forming capabilities will benefit entire community and see use for many experiments
  - Low background facility will see continuous use
  - Establishing basis for geology and microbiology programs
- Developing experienced staff, administrative framework for successful experimental programs at DUSEL


There’s real gold
at the end of this rainbow!